NOVEMBER 1957

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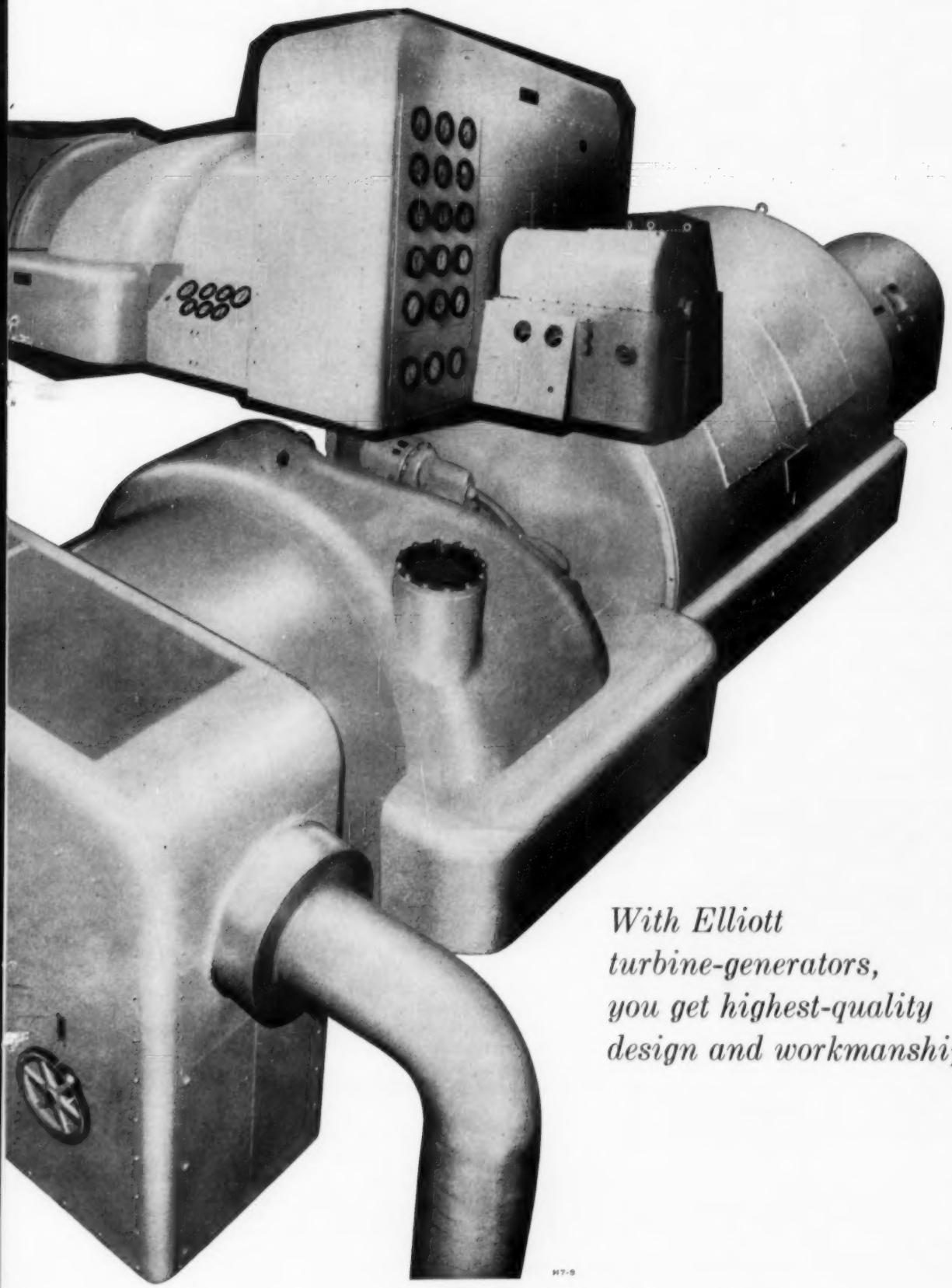

With Elliott turbine-generators, you get highest-quality design and workmanship

H7-9

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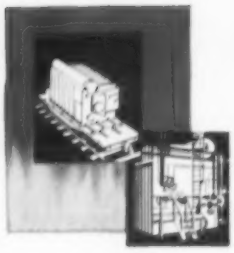

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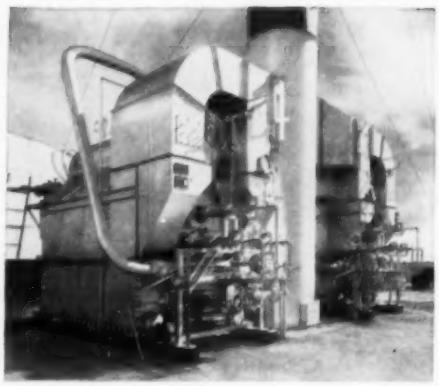
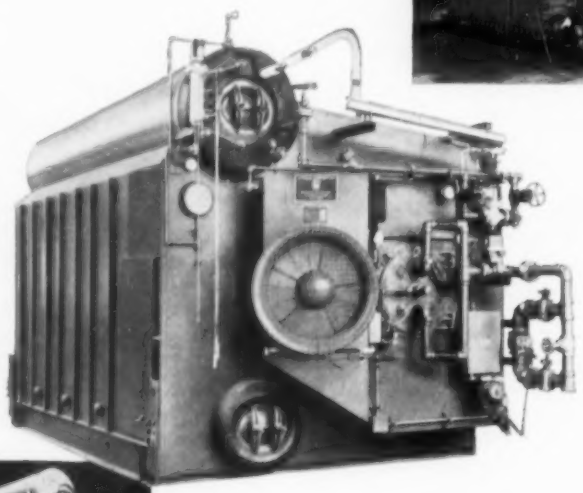
extends Central Station Reliability to Standard INDUSTRIAL and PACKAGED UNITS

PACKAGED STEAM GENERATORS of the water-tube type were introduced by Foster Wheeler in 1940 — combining in a single, compact, shop-assembled unit, all the necessary facilities for the dependable and economical generation of industrial steam. Continual research and development have resulted in further improvements in design and construction, and today the FW line of Packaged Steam Generators, in capacities from 10,000 to 60,000 lb/hr, represents the last word in modern steam plant design, reflecting over half a century of service to the power generation industry. Features include 36″ steam drum and 24″ water drum, staggered boiler tubes, closely spaced waterwall tubes, water-cooled target wall, and wide choice of burners and controls.

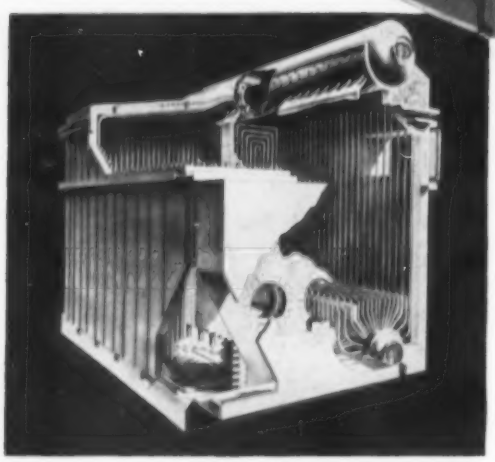


Above: Two FW packaged boilers — the first ever offered to industry — were installed for oil field drilling operations in 1940. They are still in service, delivering low-cost steam.



Left: New Foster Wheeler series AG-100 Packaged Steam Generator.

Cutaway view of typical FW Standard Steam Generator



STANDARD PRE-ENGINEERED UNITS by Foster Wheeler offer all the advantages and economies of *standardization* for larger industrial steam generators of from 50,000 lb/hr to 450,000 lb/hr capacity. The new FW line of "SC" and "SD" standard units is heat engineered to the same standards of dependability and performance which have made Foster Wheeler steam generators first choice in many of the leading central station plants throughout the country. Features include completely water cooled walls, efficient firing arrangement, fully drainable superheater, high steam purity, unrestricted circulation, pressure-tight construction and minimum refractory baffling. For further details, send for Bulletin B-55-4.

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ENGINEERS' PREVIEW

NEW NAME has been announced for the National Committee for the Development of Scientists and Engineers. It's now The President's Committee on Scientists and Engineers. Chairman is Dr. Howard L. Bevis, president emeritus of Ohio State University.

In September the Committee inaugurated the first of a nationwide series of clinics designed to focus constructive thinking on the shortage of top-quality scientists and engineers. Held in Charleston, W. Va., this meeting was sponsored by West Virginia University's College of Engineering and the West Virginia Society of Professional Engineers.

Similar conferences have been scheduled for Houston, Denver, Boston and University Park, Penna., and are expected to lead up to a national conference at which the nation's biggest employers of scientific manpower would consider the working principles set up by the earlier meetings for improving our utilization of scientists and engineers.

From this clinic series, The President's Committee plans to develop a pattern of tested methods for assembly into a kit of approved techniques for industry nationally.

U. S. CHAMBER OF COMMERCE has entered the campaign to control the tactics used by employers seeking future employees on college campuses. The Chamber has joined with the College Placement Council, Inc, in the publication of a pamphlet called Principles and Practices of College Recruiting. Copies are available from the Chamber at 1615 H St, NW, Washington 6, D. C., at 25 cents a copy, $1 for ten, or $6 for 100.

Questionable recruiting tactics, the Chamber says, have arisen with the increase of organizations actively seeking employees on college campuses. Today there are 6000 such organizations, as compared with only 1500 before World War II.

Among practices disapproved by the new recruiting guide are the bidding up of salary offers by competing employers, elaborate entertainment of prospective student employees, special payments or other gifts, any undue influence on student job choices by faculty members, and expense account padding by students visiting company plants.

GEORGE WESTINGHOUSE MEDAL for eminent achievement in the power field of mechanical engineering has been awarded to Alfred Iddles by the Board on Honors of ASME. Mr. Iddles is president of the Atomic Industrial Forum and a member of the board of directors of the Babcock and Wilcox Co. A pioneer in efforts to apply nuclear energy to peacetime uses, he has previously been active in organization and direction of engineering projects, particularly power plants, for a number of years, both in this country and in Canada and South America.

He is a former president of Babcock and Wilcox, and has also been a vice president and director of the Atomic Industrial Forum, and a past manager and vice president of ASME.

The Westinghouse Medal will be presented to Mr. Iddles at a banquet during the Annual Meeting of ASME in New York in December.

FREE COPIES of the 1957 edition of Recommended Practice for Repair Welding and Fabrication Welding of Steel Castings are offered to POWER ENGINEERING readers by Tempil Corporation, 132 W 22nd St, New York 11, N. Y.

This 52-page handy reference manual is the result of a research project conducted by Battelle Memorial Institute under the sponsorship and direction of the Steel Foundry Research Foundation. It represents the first revision of this manual since 1951 and contains a considerable amount of new material. For instance, the classification of electrodes by trade

name has been expanded from nine pages to 19 pages. Publisher of the manual is the Steel Founders' Society of America.

The material is divided into three sections and a bibliography. The three sections cover welding methods, electrodes, and recommended welding procedure for carbon-steel and low-alloy steel castings.

● EVER SEEN A SQUARE BUBBLE? Peter Senio has. He's a metallurgist at the Knolls Atomic Power Laboratory operated by GE for the Atomic Energy Commission. Brilliantly colored at first and microscopic in size, square and rectangular bubbles show up in lithium fluoride crystals after these have been irradiated with neutrons in a reactor, then heated above 600 C (1112 F).

Senio claims that square bubbles have never been seen in any other material, and believes that the formation of helium and tritium gases in the irradiated lithium may be responsible for the bubbles. Just why, he doesn't know yet.

● **SWITCHING REVOLUTION: we're in the midst of it, says John H. Van Vleck, dean of engineering and applied physics at Harvard. He's referring to the changes that are taking place in our clerical, bookkeeping, and computational devices — all of which come under the heading of Switching Theory, the theoretical basis for automation.**

Comparing this new revolution to the industrial revolution of the 19th century, Van Vleck addressed an international group on the Theory of Switching at Harvard's Computation Laboratory. He said:

"Both revolutions center around labor-saving devices, in one case physical labor, in the other case clerical or computational labor. Both free mankind from labor of a drudging sort. Both revolutions also make possible new vistas, projects, and technologies which would be completely impossible with earlier methods: in earlier days, the power to drive a steamboat, or now, the lightning computation required to guide a guided missile or satellite."

A paper prepared by Michael A. Gavrilov, of the Academy of Sci-

ences in Moscow, was read at this meeting. Among other Russian achievements in this field is a machine which analyzes relay networks. Once a relay network is designed, this machine can be used to check whether or not it will perform as its designer wishes, without logical contradictions in its structure. It is said to be more fully automatic and capable of handling more variables than any other similar device built in this country.

● BOUQUET TO BAILEY. Highest honor the ASME can bestow will be given to E. G. Bailey, former president of the Society and until his retirement, a vice president of Babcock & Wilcox. Bailey will be made an honorary member of the Society. Born in Ohio, Bailey attended the State University where he became interested in coal combustion. He developed the Bailey boiler meter, a form of water-cooled furnace wall construction, and a non-flooding feeder, all of which are said to be in use throughout the world. For many years, Bailey has also been known for his leadership in the education and development of young engineers. He lives in Easton, Penna.

● **MOVE-UPS at Stone & Webster Engineering Corp have come for Fred W. Argue, vice president and engineering manager, and Edward J. Ford, vice president and senior construction manager. Both men have been elected directors of the firm.**

● $5,000,000 DISPLAY of air conditioning and refrigeration equipment for all kinds of use will feature the 10th annual Air Conditioning and Refrigeration Exposition, to be held Nov. 18–21 in Chicago's International Amphitheater. The show is sponsored by the Air Conditioning and Refrigeration Institute, Washington, D. C.

● **BETTER BEARINGS and lubricants is the long-range objective of a new research program to be conducted by Rensselaer Polytechnic Institute under the sponsorship of Miniature Precision Bearings, Inc, DuPont, General Electric, Grumman Aircraft Engineering Corp, Shell Development Co, and Socony Mobil Oil Co. Work on friction and lubrication, fatigue of materials and colloid science will be done under the supervision of George H. Lee, RPI's director of research.**

● BIG HEAT PUMP, said to be the largest of its type in the country, will deliver 125,000 cu ft of winter-conditioned air per minute for the new plant of Flick-Reedy Corp near Chicago. Reversed in summer, the system will cool all factory and office areas of the 220,000-sq ft plant. Cost of the pump is reported to be around $500,000.

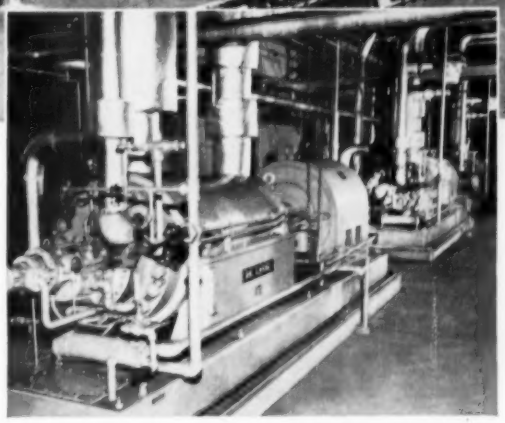
● **NEED TO KNOW MORE, on the part of engineers working in industry, has been brought out in a survey conducted by the Opinion Research Corp for the Professional Engineers Conference Board for Industry and the National Society of Professional Engineers.**

Engineers in industry feel deficient in the non-technical skills, the survey shows, and welcome company training that will fill in the lack. Topping the list of company-sponsored training courses that engineers feel would be most profitable to them are: organization and planning, how to supervise, and how to handle people.

Survey is summarized in a booklet titled, "Career Satisfactions of Professional Engineers in Industry." This is available at $3 a copy from the National Society of Professional Engineers, 2029 K Street, Washington 6, D. C.

Modern central stations use

DE LAVAL
BARREL TYPE BOILER FEED PUMPS



Three ten-stage De Laval high pressure, barrel type boiler feed pumps, are on the line at the Deepwater Station of the Atlantic City Electric Company. Shown above is an aerial view of this station located in Penns Grove, New Jersey at the southern end of the Jersey Turnpike. Each pump delivers 675 gpm to the boiler for a total flow of 685,000 pounds per hour. Each pump operates at 1762 psi with temperature at 287 F., and is driven by a 900 hp motor.

When it came time to modernize one of their existing facilities, Atlantic City Electric Company and Gibbs & Hill, Inc., consulting engineers, chose two similar De Laval pumps to serve a new 79,000 kw generator.

IMO Pumps For Fuel Oil Service

Also doing an important job in this Atlantic City Electric Company station are De Laval IMO screw-type positive displacement pumps. They supply fuel oil to the burners round the clock.

Send for De Laval Bulletin 1506, which contains helpful data.

DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY
816 Nottingham Way, Trenton 2, New Jersey

DL-189

WHAT THEY TELL US

▶ **WHO TOOK CONNECTICUT?** In this column in September we referred to the New Jersey Power & Light Co studying the possibility of building a pumped storage hydroelectric project on the Rockaway River. We got this news from Joe Halloran, our New York district manager, who reported that this was "the first one on the Eastern seaboard."

Now Connecticut Light & Power Co reminds us that their Rocky River hydroelectric generating plant on the Housatonic River has been operating since 1928 and includes a system of pumps which help fill a reservoir by taking water from the Housatonic. The company writes good-humoredly to Joe:

> Hey, Joe! Please don't let your Editor remove the state of Connecticut from the Eastern Seaboard.

To this, Joe has replied:

> Hey, Editor! Joe didn't remove it. The editor of the Newark *News* or the public relations man of New Jersey Power & Light did. Honest, I didn't take it (Conn.).

Anyway, now we're straight on who's first (we guess).

▶ **EJECTORS INSTEAD OF FANS,** to move boiler combustion air, is a suggestion that comes from Reader A. K. W. Braun of St. Louis. He writes:

> Thank you for sending a reprint of the article by C. J. Linck, Can Air-Operated Ejectors Solve Your Problem, from the June, 1956 POWER ENGINEERING.
>
> One of the costly items of powerhouse maintenance is the wear and tear of fan parts by erosion of metal by fly ash in the induced draft system in the boilers. It would seem that there is a possibility of moving large volumes of boiler furnace combustion products with air-operated ejectors in a parallel arrangement to expedite repairs without loss of output.
>
> A system such as this would not require costly dynamic balancing of rotating parts. It would provide means of partial compression of flue gas, to get high velocity ejection from stacks by nozzle devices, with better dispersion by jet action to higher atmospheric levels, thus helping solve the air pollution problem. It might also be part of the answer to dispersion of radioactive venting, i.e., feedwater heaters and the like.
>
> It's an interesting idea. But what would be the motive power and would it cost more than motor power? Also, how much space would ejectors require, as compared to fans?

▶ **STEAM PIPING** for 2600 psi at 1065 F is a complicated matter that has been on the mind of Nederlandsche Electrolasch Maatschappij N.V. of Leiden, Holland. We asked Sabin Crocker, author of the Piping Handbook, to help in supplying our Dutch friends with the most authoritative information on this difficult subject. Crocker sent papers of his own as well as recommending other sources. Now comes this note from Leiden:

> We wish to extend to you our very best thanks for the elaborate information you have been kind enough to collect for us. The different documents contain lots of interesting stuff and will no doubt assist us in solving the problems we have temporarily to face. We are very happy having consulted you in this matter.

▶ **MORE ON AIRCON,** a new word that was coined in this department in September: you'll remember that Reader R. M. Francis suggested that "Aircon" be adopted as an official abbreviation for air conditioning. Now Reader Fred P. Kessler, engineering manager of Miller Brewing Co, writes:

> In reference to "Aircon," appearing on page 6 of the September, 1957 issue of POWER ENGINEERING: I typed it, I wrote it and I rolled it around on my tongue; but I liked it better when it came out "Con-Air" or "Conair."

▶ **DARKE DISCUSSION** is started here by Reader M. T. Charles, who has been pondering over R. D. Darke's article on H-T H-W Controls, in the September issue, page 77. Charles comments:

> I have found Mr. Darke's explanation of the problems encountered and their solutions most illuminating. It appears to me, however, that the designers of these systems could do a great deal to remove some of the toughest control problems, and to improve the operation of the system as well: simply adopting the type of pressurizer being used so successfully in the pressurized-water-reactor systems.
>
> Mr. Darke goes to some lengths to circumvent the difficulties encountered when steam rises from the drum to the expansion tank. Of course steam is going to do this — how else would it get up there? He mentions a nitrogen-pressurizing system, shown in the article in Fig. 8, as being too elaborate.
>
> Why not just an externally-fired vessel maintaining a head of steam at any predetermined pressure? Fired electrically (off-on or saturable-reactor control) or by oil or gas, the heat required is a negligible part of the total heat requirements of the system, and the pressure control can be virtually perfect, and entirely independent of load.
>
> Also, the pressurizer will serve as a surge tank, and may be equipped with bleeding and charging valves to keep within any predetermined levels.
>
> Are the designers missing a good bet here, or are there some factors I don't know about?

▶ **LONG LIFE** and usefulness are what we try to build into POWER ENGINEERING articles; so it's gratifying when proof comes along that this quality is real. G. A. Weidemier, of the American Association's Council on Hospital Planning and Plant Operation, has sent us copies of a recent issue of the Hospital Engineers' *Newsletter*. Its lead article is a reprint of an article that appeared in POWER ENGINEERING way back in September, 1956. Writes Weidemier:

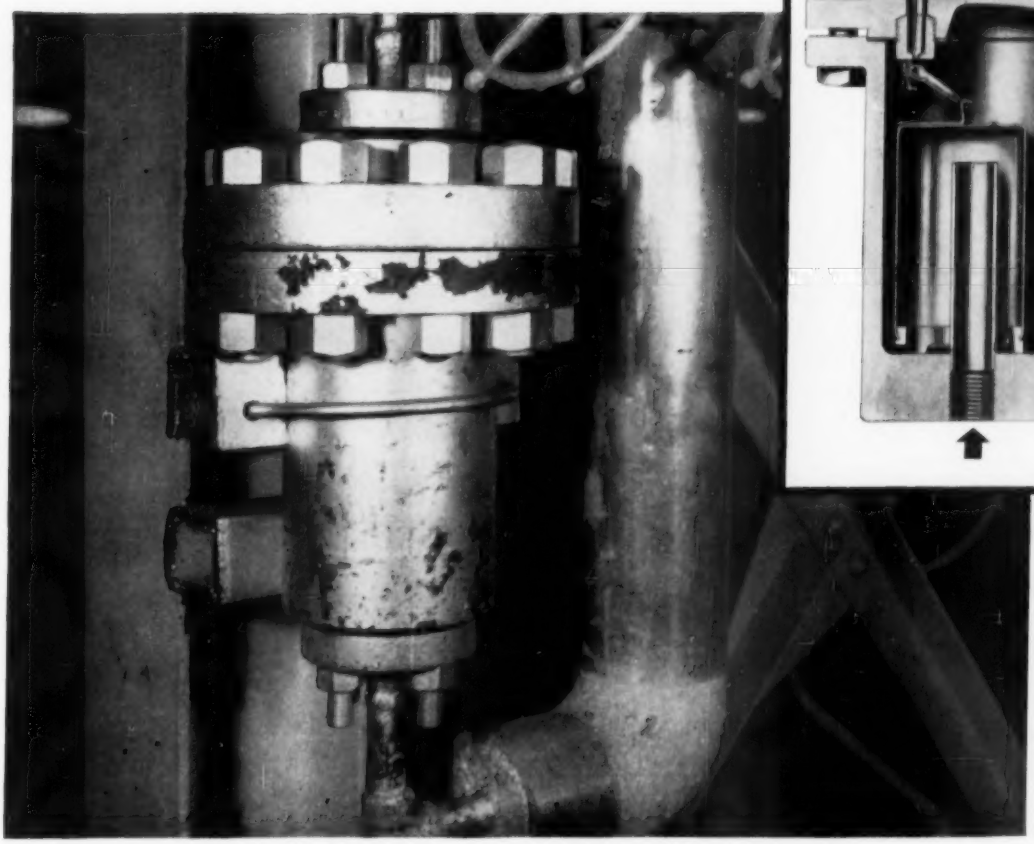
> In this issue we reprinted the article by Frank Kumke on solving a heating problem with a booster boiler, from page 108 of your September, 1956 issue. This article made a very good feature for this issue of the *Newsletter*, and we appreciate your permission to use it.

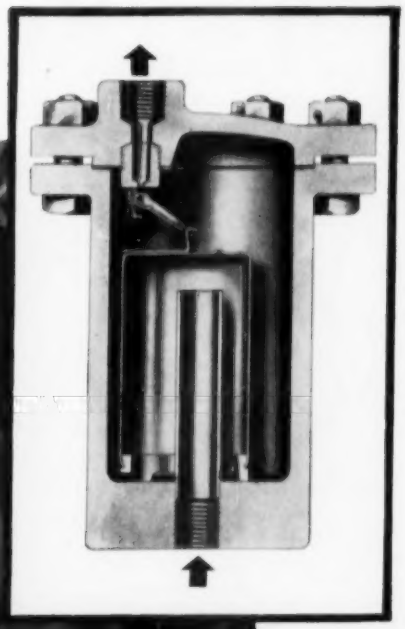
▶ **THIS REQUEST** comes from Reader A. K. W. B.:

> At different times your periodical has run articles on central station and other steam turbines. Somewhere in years past in this material there was a statement on the proportion or percentage of work accomplished on the turbine shaft by the steam, from slightly above atmospheric pressure down to condenser vacuum, with the then more-or-less prevalent steam conditions, i.e., 850 psi, 900 F. If my memory is correct, this percentage was of the order of about 40 per cent of shaft work at maximum load, up to a considerably greater per cent under lower range loads. Can you help me?

We've given Mr. B. some data on this, but we'll welcome further comment on it from readers.

ARMSTRONG FORGED STEEL STEAM TRAPS . . .





. . . the Best Answer to Superheated Steam Line Drainage, because:

LIST OF MATERIALS
ARMSTRONG FORGED STEEL TRAPS

Part	Material
CAP AND BODY FORGINGS Up to 600 psi, 750° Up to 900 psi, 900° Up to 2500 psi, above 900°	 1030 carbon steel ASTM Spec. F-1 carbon moly steel ASTM Spec F-5 chrome moly steel
VALVE AND SEAT	Type 440 chrome steel, heat treated, standard. Stellite available.
LEVER MECHANISM	Stainless steel
BUCKET	Stainless steel
BOLTS	Class C high tensile, high temperature bolting material—125,000 min. tensile.
NUTS	Hex, semi-finish, heat treated for high pressure, high temperature service.
GASKET	Compressed graphited asbestos
INLET TUBE	Wrought iron

1. **Proved** in service in leading power plants throughout the world at pressures to 2400 psig.

2. **Experience** of Armstrong in design, manufacture and application dates back to the *beginning* of the trend to higher and higher pressures.

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4. **Economy** assured because of high value for price, long life with infrequent maintenance and freedom from steam loss.

5. **Quality** of workmanship and materials that is backed by a "complete satisfaction or your money back" guarantee.

Application Engineered
STEAM TRAPS

SEND FOR THIS LITERATURE:

1. Should we trap superheated steam lines? — the answers of 11 engineers who have used traps for this service.

2. Catalog J — complete data on forged steel traps and steam trapping.

ARMSTRONG MACHINE WORKS, 8102 Maple Street, Three Rivers, Michigan

For more data circle 504 on Post Card

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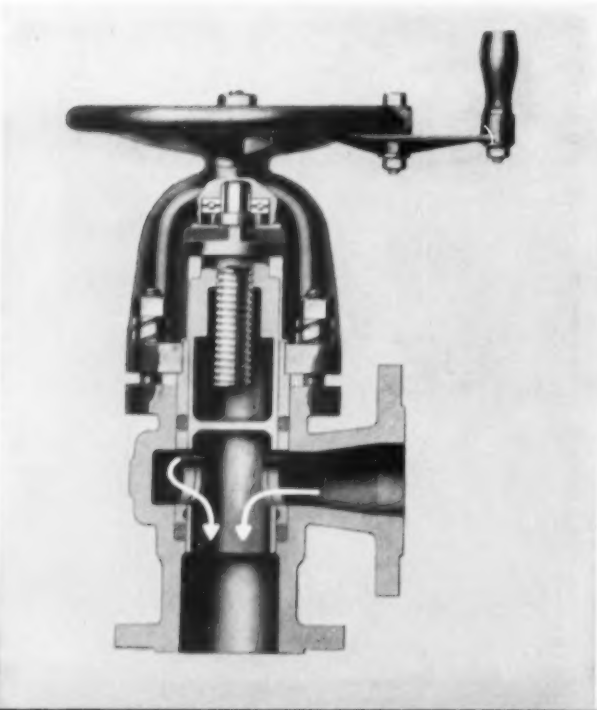
Features balanced nitralloy hollow plunger that seals line drop-tight, yet permits free, unobstructed flow in blow-down. Other features —laminated packing, alemite lubrication, ball thrust bearings. USED SUCCESSFULLY IN OVER 15,000 BOILER PLANTS.



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USED IN OVER 15,000 BOILER PLANTS

serve every boiler blow-down need

■ Whatever your *pressure* requirement, whatever your *piping* requirement—there's a Yarway Blow-Off Valve to exactly meet your needs.

Popular Yarway *seatless* design keeps blow-down lines drop-tight in low and medium pressure ranges. Sturdy Yarway *stellite seat and disc* design protects higher pressures.

All Yarway Blow-Off Valves are strong, rugged valves, built to withstand the punishment of regular or emergency blowing-down under full boiler pressure, and are available in metals that stand up under acid washing of boilers.

Write for new Yarway Blow-Off Valve Bulletins—B-426 (pressures to 400 psi) or B-434 (pressures to 2500 psi).

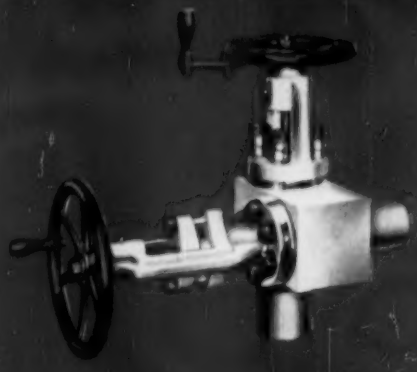
• Yarway Type B Seatless Blow-Off Valve, iron body for boiler pressures to 200 psi, steel bodies, for pressures to 400 psi. Angle valve shown, straightway available. Flanged connections. See Bulletin B-426.

• Yarway Type B Seatless Tandem Blow-Off Valve combining two angle valves. Other combinations available. Iron bodies for boiler pressures to 200 psi, steel bodies for pressures to 400 psi. See Bulletin B-426.

• Yarway Type C Seatless Tandem Blow-Off Valve combining angle and straightway valves. Other combinations available. Flanged or welding connections available. For boiler pressures to 600 psi. NOTE: When used in tandem with a Yarway Hard-Seat Valve, Type C Seatless may be used to 1500 psi. See Bulletin B-434.

• Yarway Hard-Seat Blow-Off Valve for pressures to 2500 psi. Straightway valve shown. Angle available. Welded (shown) or flanged connections. See Bulletin B-434.

• Yarway Hard-Seat—Seatless Bolted Tandem Blow-Off Valve. Hard-Seat is the blowing valve, seatless is the sealing valve. Available in any combination of connections. For pressures to 1500 psi. Hard seat-hard seat tandems for pressures to 2500 psi. See Bulletin B-434.



• Yarway Unit Tandem Blow-Off Valve. Combines a hard-seat blowing valve and a seatless seating valve in one-piece forged steel body for boiler pressures to 1500 psi. For pressures to 2500 psi, two hard-seat valves are combined. See Bulletin B-434.

LET YARWAY HELP SOLVE YOUR BOILER BLOW-DOWN PROBLEMS!

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY

blow-off valves

Correct Lubrication in Action . . .

2000 Machine

These completely automated honing machines finish to mirror smoothness cylinder walls of up to 100 V-8 engine blocks per hour. They're located in one of the Michigan plants producing one of America's most popular medium-priced cars. Machines and entire plant are protected by Mobil Correct Lubrication.

Mobil **SOCONY MOBIL**

Leader in Lubrication for over 91 years

in the **Automotive Industry**

Production Hours Saved

6000 REPAIR MAN-HOURS ELIMINATED!

Two of many cost-cutting benefits achieved by this leading automobile company with the help of Socony Mobil

The machines used to produce this automobile company's V-8 engines are so complex and closely interlocked that the failure of one small part may result in the shutdown of an entire production line.

That's why company management recommended the adoption of a planned lubrication program . . . decided on the depth of service offered by Socony Mobil Correct Lubrication. Under this comprehensive program, plant personnel and Mobil engineers coordinated their efforts so effectively that the size and number of maintenance savings have significantly added to company profits.

To cite one example—After surveying 650 hydraulically operated machines in this company's axle and motor plants, Mobil engineers noted use of 8 different hydraulic oils. Their varying performance caused excessive downtime, constant repairs, short oil batch life. Minor machine modifications suggested by Mobil engineers permitted use of a *single* wide-range high quality Mobil hydraulic oil. In just two years, this change made available 2000 additional production hours . . . eliminated 6000 repair man-hours . . . saved 10000 gallons of oil.

* * *

Here's another example of Correct Lubrication in action...proof that it can pay to rely on Socony Mobil.

More Savings—made with the help of Socony Mobil Correct Lubrication

This chart gives some idea of the extent and size of savings achieved through the knowledge, service, facilities and quality products available through Mobil Correct Lubrication.

	Machine Production Hours Saved	Machine Repair Man-Hours Saved	Repair Parts Saving	Savings Period
Hydraulic Systems	2000	6000	Not Recorded	1953-55
Trio Nut Runners	138	276	$1610.	1952-55
Air Wrenches (Motor Assembly)	Not Recorded	188	Not Recorded	1952-55
Bullard Chucks	82	328	Not Recorded	1952-55
Landis Wheel Dresser Bearings	Not Recorded	Not Recorded	87½%	1952-55
Keller Air Hoist	Not Recorded	276	$8970.	1952-55
Ex-Cell-O Cylinder Boring Machines	100	800	$8750.	1952-55

Correct Lubrication

A proved program to reduce equipment maintenance costs

SOCONY MOBIL OIL COMPANY, INC., and Affiliates: MAGNOLIA PETROLEUM CO., GENERAL PETROLEUM CORP., MOBIL OVERSEAS OIL CO., INC.

For more data circle 506 on Post Card

Aerial view of the International Paper Company plant at Corinth, New York

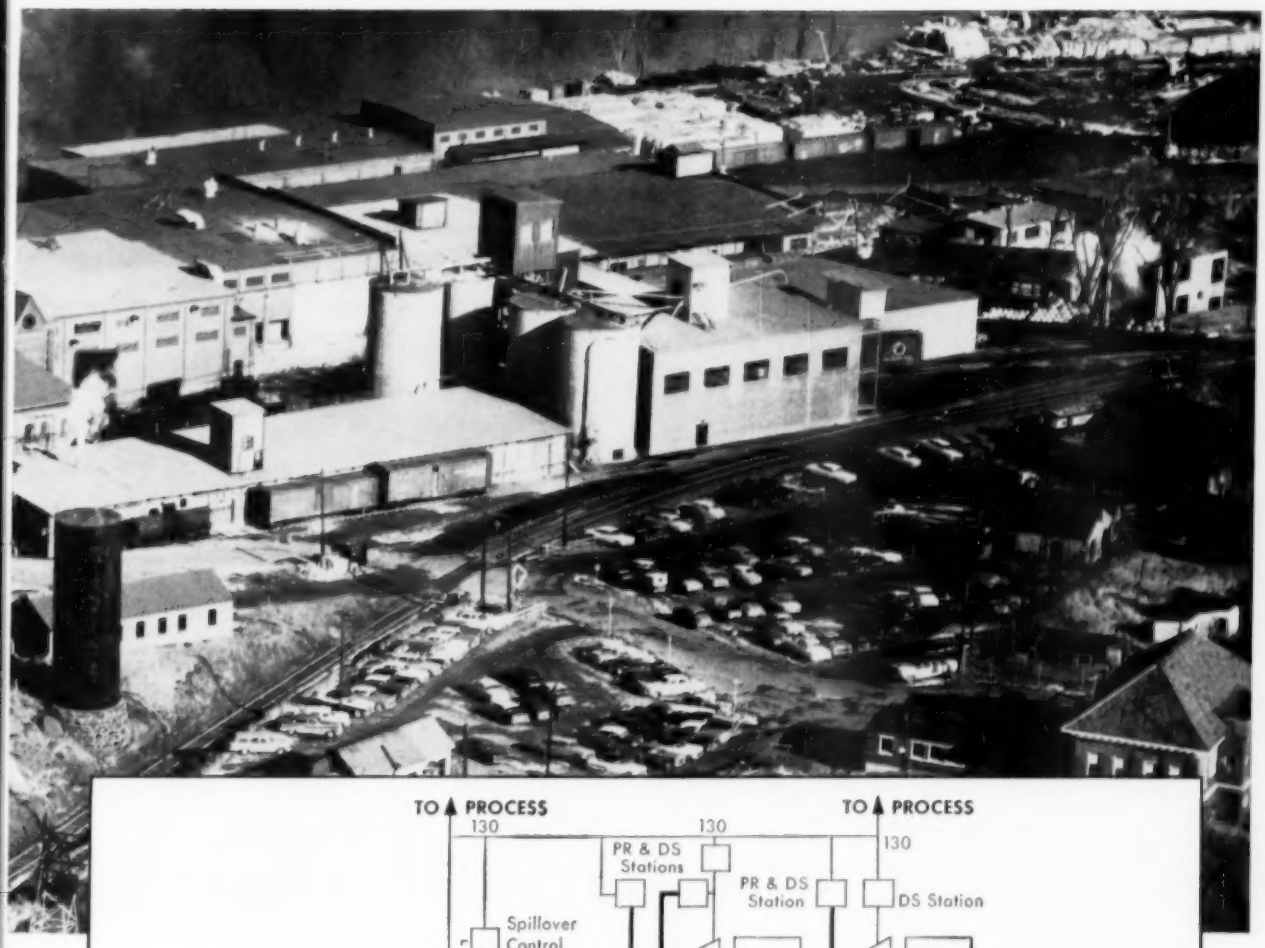
Need help with steam plant expansions? I. P. Co.'s Hudson River Mill has used HAGAN...since 1936

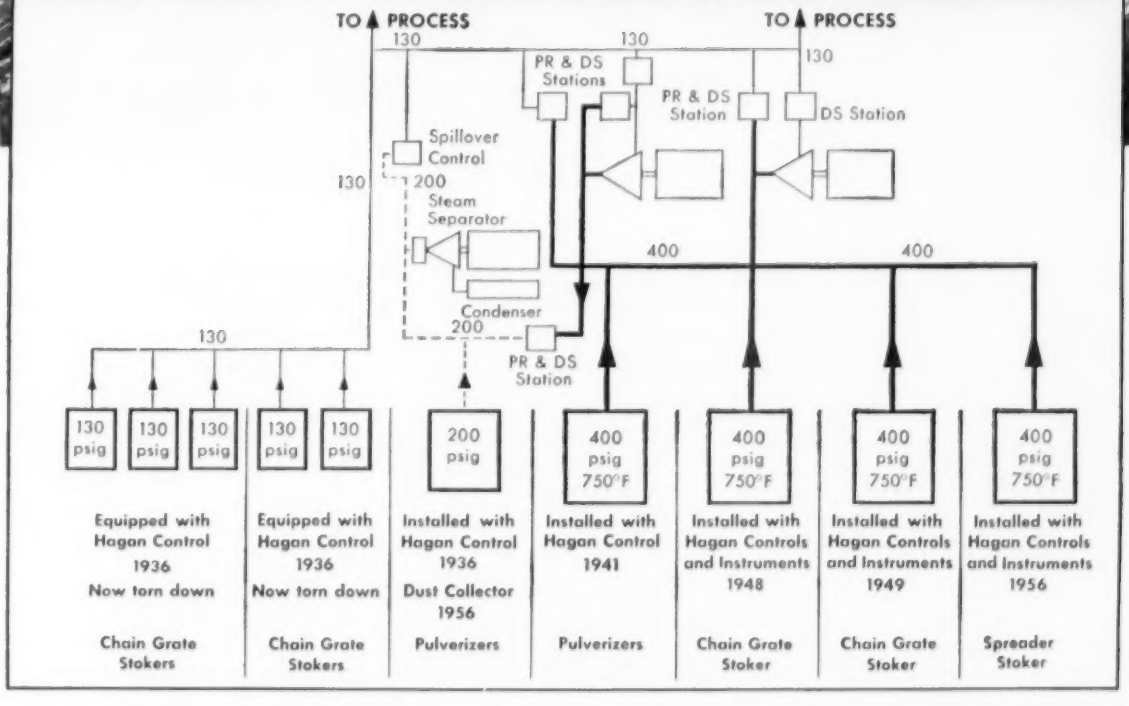
In 1936, the International Paper Company plant at Corinth, New York, decided to install automatic controls on the five boilers then in service (see chronological diagram at right). A Hagan system was chosen for the first three boilers to be converted. Subsequently the remaining two boilers were also put on Hagan automatic combustion control.

Since then, as plant expansions presented new problems of boiler operation and steam distribution, Hagan combustion controls, pressure reducing and desuperheating stations, spillover controls and other systems were added.

Hagan equipment is also used for steam separation, paper machine drying control, water temperature control and chemical feeding systems. In 1956, a Hagan Dust Collector was installed on Boiler No. 7 to control fly ash in the shipping area. Hagan is proud of so long a record of continuous service, and of the results that have been achieved.

Hagan engineers have more than 37 years of experience in the application of accurate, dependable Hagan equipment to combustion control problems of all kinds. Why not put this experience to work on your control problems.





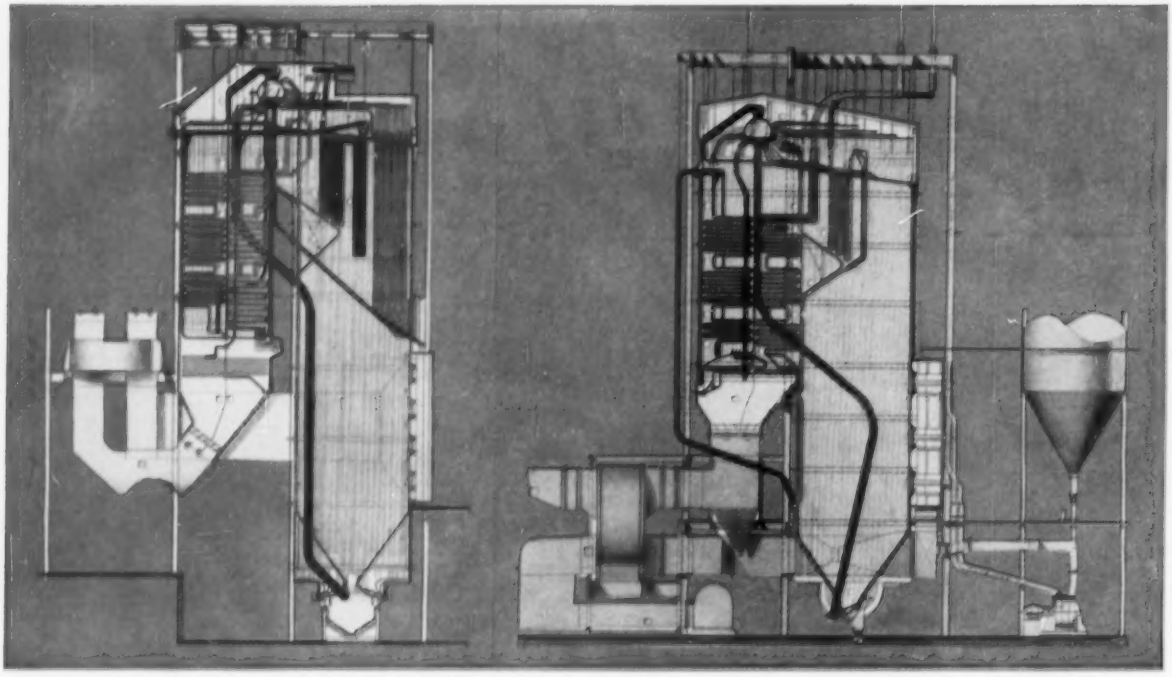
HAGAN CHEMICALS & CONTROLS, INC.

HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY, HALL LABORATORIES
IN CANADA: HAGAN CORPORATION (CANADA) LIMITED
OFFICES IN: MONTREAL, TORONTO, VANCOUVER, EDMONTON

For more data circle 507 on Post Card

Current RILEY Reheat Designs

PULVERIZED COAL FIRED



Central Illinois Light Company — R. S. Wallace Station
690,000 lbs/hr; 1650 psig; 1000/1000 F
Commonwealth Associates, Inc., Consulting Engineers

Minnesota Power & Light Co. — Clay Boswell Station, Duluth
Two Units — 500,000 lbs/hr; 1725 psig; 1005/1005 F
Ebasco Services, Inc., Consulting Engineers

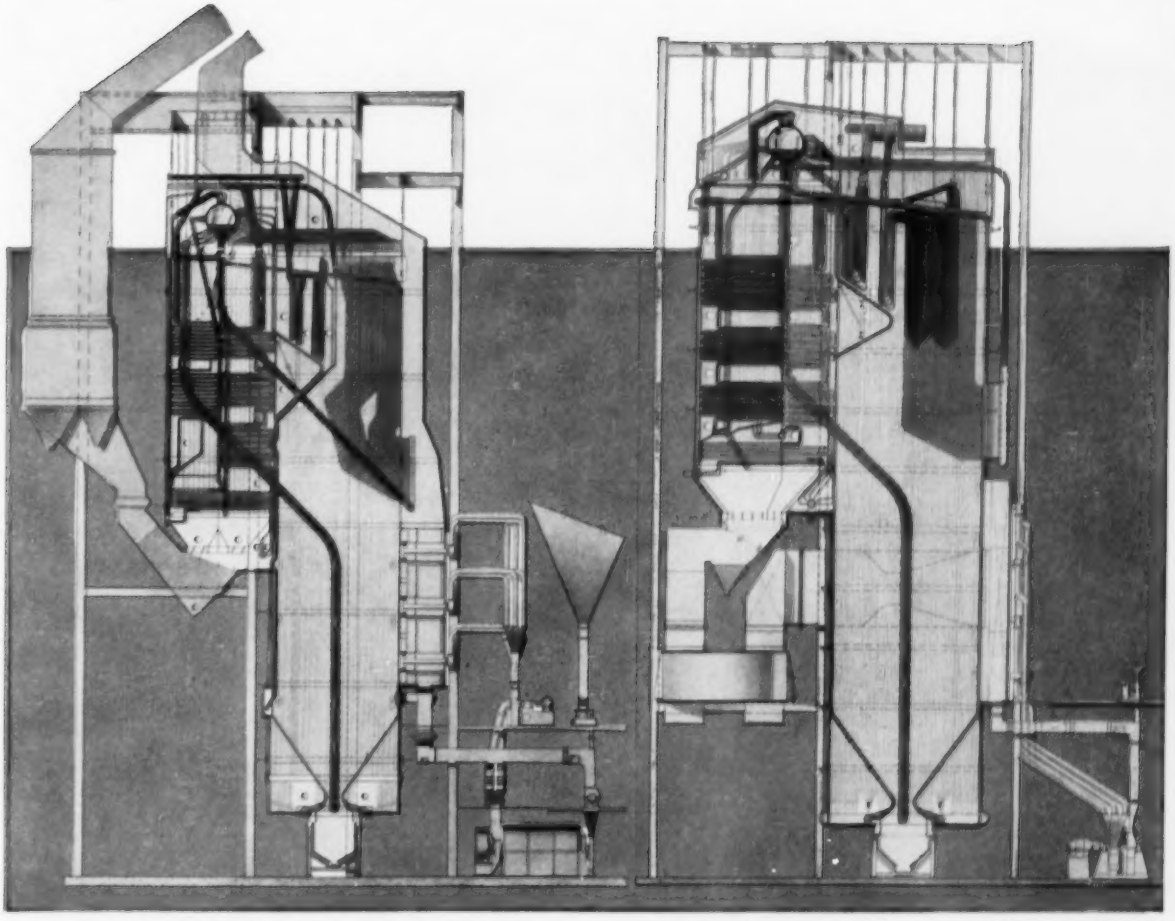
The use by public utilities of Riley Reheat Units for all capacities and steam conditions has climbed rapidly and steadily during the past decade. This gratifying acceptance is the result of the record of performance, dependability and continuity of operation established by Riley units.

The designs illustrated on these pages are typical of those currently being supplied for pulverized coal firing. They are just a few of many Riley central station designs. Let our sales engineers show you others.

A survey of your plant by a consulting engineer could show ways of making surprising savings in your power costs.

RILEY
Stoker Corporation
WORCESTER, MASSACHUSETTS

Sales Offices: Worcester, New York, Philadelphia, Buffalo, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Houston, Denver (Englewood), Salt Lake City, Los Angeles, San Francisco, Portland, Seattle.



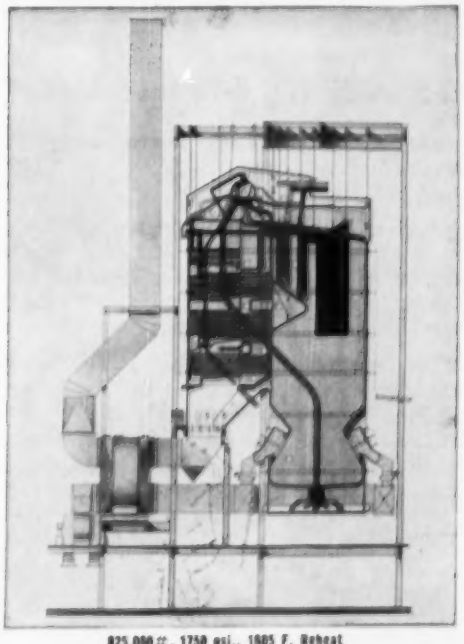
Public Service Co. of Indiana, Inc. — New Albany
Two Units — 1,000,000 lbs/hr; 2075 psig; 1005/1005 F
Sargent & Lundy, Consulting Engineers

The Hartford Electric Light Co. — Middletown, Conn.
800,000 lbs/hr; 2100 psig; 1005/1005 F
Stone & Webster Engineering Corp., Consulting Engineers

The RILEY TURBO FURNACE

the design of the future that's HERE!

Since late 1955, when this design was first announced, 19 Riley TURBO FURNACE boilers in capacities from 150,000 to 1,600,000 lbs/hr have been sold, eight of them to public utilities. This rapid acceptance is a result of the TURBO FURNACE'S exceptional performance characteristics and its ability to utilize multiple fuels. Users, burning oil or gas initially, can switch to solid fuels in the future without the costly delay caused by conversion of furnace and heating surfaces. A wide range of coal, lignite or other solid fuels can be burned; with fly ash reinjection in the furnace unburned losses are negligible. In addition, the Riley TURBO FURNACE boiler has all burners on one level with a consequent reduction in overall height.



825,000 #, 1750 psi., 1005 F. Reheat
TURBO FURNACE

For more data circle 508 on Post Card

Which packing
for longer life in reciprocating service?

To 500F it's J-M Interlocked

because it cannot ravel or come apart

Made by an exclusive J-M process, Interlocked packing is braided from tough long-fibre asbestos yarns strongly interlocked in a solid integral structure. There are no jackets to wear through . . . no plaits to loosen. That's why it retains its strength and efficiency far longer than other types.

Interlocked also seals better. It is flexible and resilient, braided square for better contact and requires less gland pressure. Style 255 is effective against steam, hot or cold water, oil, weak acids and caustics. Furnished lubricated and graphited in ring and coil forms in sizes from ¼" and up.

To 750F it's J-M Superheat

because it does not harden under high heat

Designed specifically for superheated steam between 500F and 750F, Johns-Manville's Superheat packing is made of highest quality pure asbestos cloth which retains its resiliency even after long exposure to high temperatures. Woven tight, spiral wrapped and then pressed square, this cloth forms a firm resilient structure of superior strength and wearability.

Style 167 Superheat is bonded with a special heat resistant compound. No excess is present to carbonize in use. Density is carefully controlled for minimum gland pressure. Furnished graphited in ring and coil forms in sizes from ¼" and up.

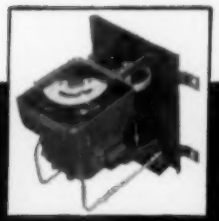
Your local J-M distributor carries full stocks of Interlocked and Superheat and other packings. Call him today or write Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

Johns-Manville PACKINGS, GASKETS and TEXTILES

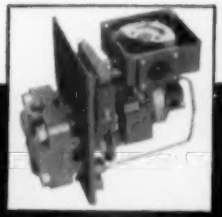
For more data circle 512 on Post Card

REPUBLIC'S new family of

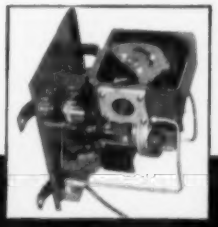
NULL-BALANCE-VECTOR* PNEUMATIC INSTRUMENTS



TYPE VP
Pressure Transmitter
Standard Ranges
0-1.5" to 0-5000 psi



TYPE VDP
Differential Transmitter
Standard Range
0-15 to 0-300" H_2O



TYPE VT
Temperature Transmitters
Standard Range
0-100° to 0-1000° F.

TYPE VC
Control Transmitters

*
Design principle which permits making extremely accurate and sensitive components that are compact, versatile and interchangeable.

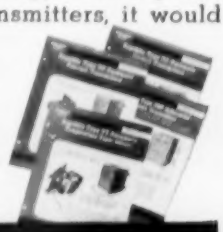
Republic's new line of pneumatic instruments includes pressure, differential pressure, temperature and control transmitters. Controllers that feature repeatable reset rate, less than 0.05% dead band and proportional band adjustment from 2 to 500%;—differential pressure transmitters with 20 to 1 range adjustment;—pressure transmitters of ±0.5% accuracy; and temperature transmitters with 10 to 1 range adjustment show the flexibility as well as the compactness, lightweight and accessibility of these instruments.

THE NULL-BALANCE-VECTOR PRINCIPLE

In terms of calibration, the null-balance-vector principle means that the span of any pneumatic instrument in the line can be varied at will . . . merely use a screwdriver and a reference . . . without re-setting zero. In terms of theory, the null-balance-vector principle means that the proportion of an input force (from a measuring bellows, bourdon tube, diaphragm, etc.) balanced by the pneumatic circuit can be varied by changing the angle at which that force acts on other links in the system. Hence, without changing air supply pressure or the measuring bellows, bourdon tube or diaphragm, the same output signal pressure range can reflect a measured input signal range that can be changed as much as 20-to-1.

Republic's new family of pneumatic instruments was developed in parallel programs that use the greatest possible number of common components. The result: High interchangeability of parts, even between instruments performing entirely different functions. Such design foresight has made the spare parts and training problems extremely simple. And Republic's null-balance-vector design means that full-range operation involves virtually no motion . . . and virtually no wear.

If you want the best sensitivity, accuracy and reliability in pneumatic transmitters, it would pay you to get full details on all four of Republic's new family of Null-Balance-Vector Pneumatic Instruments. Write for descriptive folios on each type, now.



REPUBLIC FLOW METERS CO.
A Subsidiary of Rockwell Manufacturing Company
2240 Diversey Parkway • Chicago 47, Illinois

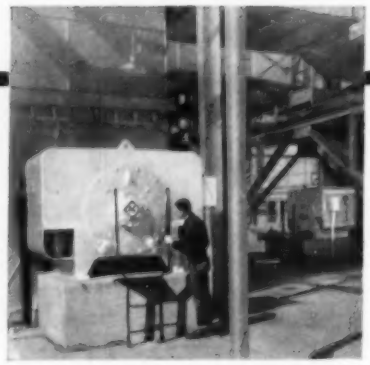
For more data circle 513 on Post Card

One of many reasons why **ALLIS-CHALMERS MOTORS** are preferred for outdoor applications for

POWER PLANTS

Space Heater is weather protected

(and corrosion-proof!)



Weather protected motor drives force draft fan.

Weather-protected heaters are standard on Allis-Chalmers outdoor motors . . . prevent moisture condensation on motor parts during shutdown periods. These immersion-type heaters are not only waterproof, they are also stainless steel clad for resistance to corrosion.

Easy Maintenance, too!

Heater terminal box mounts outside motor frame; heating element projects into motor enclosure. Open wiring inside motor is eliminated. Entire heating unit is easily removed for service or replacement.

For details on this and all the other outstanding features of Allis-Chalmers motors, call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwauke 1, Wisconsin.

A-C ALLIS CHALMERS

ALLIS-CHALMERS

A-5491

For more data circle 510 on Post Card

Industry
NEEDS DEPENDABLE
NOURISHMENT too!
Take a tip from your family's dependence on "nature's most nearly perfect food". Coal is nature's most nearly perfect fuel. It's here in abundance for ages to come, a dependably low-cost and most efficient source of "go power"! It's convenient too —right on Industry's doorstep.
B&O
BITUMINOUS COALS FOR EVERY PURPOSE
Ask our man! BALTIMORE & OHIO RAILROAD, BALTIMORE 1, MD., Phone: LExington 9-0400

For more data circle 511 on Post Card

For wider adaptation . . . and unmatched Service Life . . . . . the New

Vogt GENERAL GP PURPOSE VALVES*

We invite you to inquire into the savings which the new line of Vogt GP Drop Forged Steel Valves can make possible in your operations. Not only do their many unique and exclusive features make them more economical of operation, but their broad adaptability to so many industrial applications permits a substantial reduction in operating overhead.

Service life, too, is enhanced with Stellite faced seating surfaces which are available at no extra cost along with many other costs.

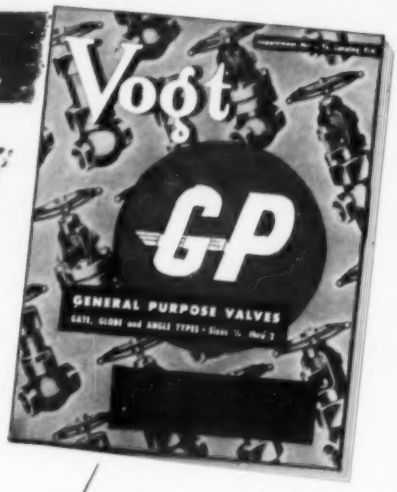
150-800 Pounds Service
(2000 pounds cold)

•

Featuring Stellite Faced Seating Surfaces

•

Sizes ¼" to 2"



HENRY VOGT MACHINE CO.
Louisville, Kentucky

SALES OFFICES: New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va., Cincinnati

FREE
Supplement No. 1 to Vogt Catalog F-9

This 32-page catalog illustrates and gives complete specifications on 11 types of the new Vogt GP forged steel gate, globe and angle valves. Send for your free copy—for ready reference in purchasing. Use the coupon for convenience.

HENRY VOGT MACHINE CO.
LOUISVILLE 10, KY.

Gentlemen:
Please send copy of New Vogt Catalog Supplement No. 1 to F-9.

Name_____

Firm_____

Address_____ City_____ State_____

....these ads tell you why

Drop forged
for Strength and Safety

Drop forging techniques, resulting from more than a half century of pioneering and development by Vogt in the production of forged steel valves, impart matchless strength and safety to the new line of Vogt GP Valves. Made from killed, clean, fine grained open hearth steel billets, forging and treatment operations result in additional grain refinement and increased toughness.

GP Valves are setting new standards of performance in petroleum refineries, chemical plants, power plants, and related industries. Available in a complete range of sizes from ¼" to 2" and rated 800 pounds at 850°F. and 2000 pounds at 100°F.

Adv. No. 4 in a series describing the features of Vogt GP Valves.

HENRY VOGT MACHINE CO.
P. O. Box 1918—Louisville 1, Ky.

Vogt GENERAL GP PURPOSE DROP FORGED STEEL VALVES

Tough valve buyers *appreciate* this kind of...
Toughness

*HAYNES STELLITE

Here's why—They know that to foil those troublesome valve "termites"—erosion, corrosion, and galling—requires built-in toughness which only seats faced with hard facing alloys AND hardened wedges can provide. Yes, it takes BOTH to do a real job and GP Valves provide both at no extra cost!

Vogt GP Valves feature the toughest and, since they are precision finished, the smoothest seating surfaces obtainable anywhere. That's why they are setting new standards of performance—longer, drop-tight service with minimum, low cost maintenance—in petroleum refineries, chemical plants, power plants and other industries. Available in a complete range of sizes from ¼" to 2" and rated 800 pounds at 850° F. and 2000 pounds at 100° F.

Adv. No. 5 in a series describing the features of Vogt GP Valves.

HENRY VOGT MACHINE CO.
P. O. Box 1918—Louisville 1, Ky.

*HAYNES STELLITE—Trade-mark of Haynes Stellite and Union Carbide Corporation

Vogt GENERAL GP PURPOSE DROP FORGED STEEL VALVES

Hard faced* Seating

...at no extra cost!

STELLITE *faced seating surfaces are among the many plus advantages offered by Vogt General Purpose Valves. Fusion welded to the renewable stainless steel seat rings of gate valves and to the integral seat of globe and angle valve bodies, tough, long-wearing STELLITE affords amazing resistance to erosion, corrosion and galling.*

The new line of Vogt drop forged steel GP's completely fills the demands of industry for a line of compact, lighter weight, shorter face-to-face valves. They assure operation economies and longer life and are available in a complete range of sizes and types from ½" to 2". They are rated 800 pounds at 850° F. and 2000 pounds at 100° F. Send today for free catalog.

Adv. No. 2 in a series describing the features of Vogt G.P. Valves.

Write for free 1952 GPV-21 Supplement No. 1 to Catalog 14

HENRY VOGT MACHINE CO.
P. O. Box 1918 • Louisville 1, Kentucky

SALES OFFICES:
New York, Philadelphia, Cleveland, Chicago, St. Louis, Charleston, W. Va., Cincinnati, Dallas

Vogt GENERAL PURPOSE GP DROP FORGED STEEL VALVES

Hard faced WITH STELLITE* to resist seat wear ...at no extra cost!

GP Globe Valve-Series 800

Stubborn resistance to valve seat wear, due to erosion, corrosion and galling, is built into Vogt GP valves with Stellite faced seating surfaces used in conjunction with hardened discs and wedges. By an exclusive method, hard facing alloys are welded to the integral seat of globe and angle valve bodies and to the renewable stainless steel seat rings of gate valves.

This important feature, available at no extra cost, assures operation economies and longer valve life. A catalog describing the complete General Purpose line of valves in sizes ¼" to 2" will be sent on request.

Adv. No. 1 in a series describing the features of Vogt GP valves.

Write for free 1952 GPV-21 Supplement No. 1 to Catalog 14

HENRY VOGT MACHINE CO.
P. O. Box 1918 • Louisville 1, Kentucky

SALES OFFICES:
New York, Philadelphia, Cleveland, Chicago, St. Louis, Charleston, W. Va., Cincinnati, Dallas

Vogt GENERAL PURPOSE GP DROP FORGED STEEL VALVES

VOGT GP valves are better

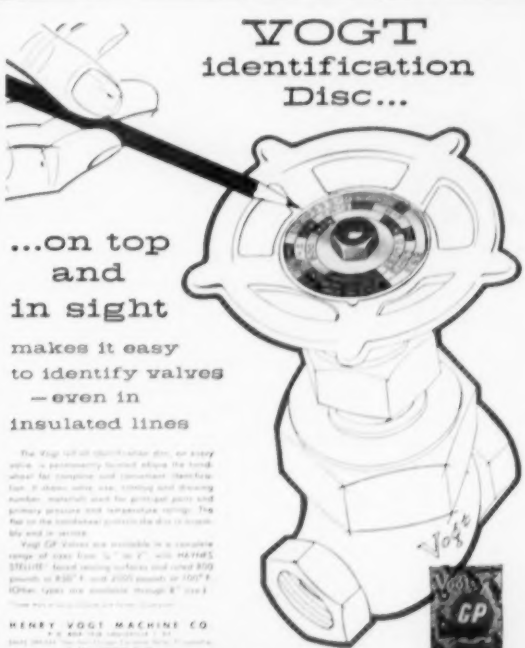
Heat and wear-resisting stainless steel yoke nuts in Vogt Valves give longer trouble-free service. We have proved this in our own "Torture Chamber, under constant and accelerated testing, as well as in tough service applications. They are made from a special stainless steel alloy having excellent bearing quality, manifold strength, and a melting point of approximately 2700° F.

The rotating gate valve yoke nut design, illustrated, has flats for a tight fit with the square broached hole of the handwheel. Non-rotating yoke nuts, for globe and angle valves, are of the same superior design and quality. Vogt GP Valves are available in a complete range of sizes from ½" to 2" and rated 800 pounds at 850° F. and 2000 pounds at 100° F.

Adv. No. 6 in a series describing the features of Vogt GP Valves.

HENRY VOGT MACHINE CO.
P. O. Box 1918 • Louisville 1, Ky.

Vogt GENERAL PURPOSE GP DROP FORGED STEEL VALVES



HENRY VOGT MACHINE CO.
P. O. Box 1918 • Louisville 1, Ky.

Vogt GENERAL PURPOSE GP DROP FORGED STEEL VALVES

Chicago's newest is served

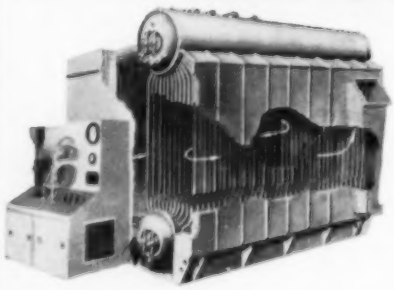
Located on a 100 acre site overlooking Lake Michigan, Chicago's newest planned community, the Lake Meadows project, offers gracious living within the confines of a large city. Owned and managed by the New York Life Insurance Company, Lake Meadows provides distinctively appointed apartments, spacious grounds, a modern shopping center, ample parking facilities, yet is within minutes of the heart of the city. When completed, this project will house 2000 families and will include an eight acre park. In addition, construction has already begun on a new elementary school located on a two acre plot adjacent to the housing development.

A project of this size requires considerable steam capacity to provide ample heat and hot water and to perform the many other services required. To do the job, the New York Life Insurance Company originally selected 3 C-E Package Boilers, Type VP. Later, as new housing units were added, 2 additional VP Boilers were installed. Their outstanding performance and efficient, trouble-free operation is evidenced by the repeat order placed with Combustion for the final 2 units.

VP Boiler Catalogs are available on request.

VP ADVANTAGES

VP Boilers are completely shop-assembled . . . available in fourteen sizes from 4,000 to 50,000 lb steam per hr . . . for pressures up to 500 psi . . . for oil or gas firing. They have more water-cooled area per cubic foot of furnace volume . . . a 30-inch diameter lower drum which gives more water storage capacity and easy access . . . quiet, low-speed centrifugal fan. They require only a simple concrete slab foundation.



COMBUSTION

Combustion Engineering Building

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS.

planned community
by C-E Boilers

Architect's rendering of the Lake Meadows project. Skidmore, Owings and Merrill, Architects.

AT FAR LEFT – Cutaway view of typical VP Boiler. This model has integral console control panel.

AT LEFT – Firing aisle of the Lake Meadows boiler room showing three of the five C-E Package Boilers, Type VP.

ENGINEERING

200 Madison Avenue, New York 16, N. Y.

C-E

B-9660

PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

For more data circle 514 on Post Card

The Power Plant Engineer Said:

"I WOULDN'T KNOW..."

INQUIRING REPORTER: So you use Nalco System water treatment ... How often are your boilers turbined?

ENGINEER: I wouldn't know — only worked here seven years.*

* You recognize the Engineer's answer as a twist on the old one about *How-often-do-you-get-a-raise-around-here.* Our excuse for bringing it up is that the engineer's answer applies to hundreds of plants using Nalco water treatment. New plants, starting boilers from scratch with Nalco, report years on line, *billions* of pounds of steam generated in boilers that have *never* been turbined ... and probably never will be. Older plants, where turbining was as routine as checking the draft gauges, now open boilers only to show the inspectors.

These Nalco *results* can quite possibly be duplicated in your plant, regardless of the kind or severity of your water treatment problems ... or the size of your operation. Write or phone, now, for a fast start toward permanent water treatment security.

NATIONAL ALUMINATE CORPORATION

6224 West 66th Place • Chicago 38, Illinois

Telephone: POrtsmouth 7-7240

In Canada: Alchem Limited, Burlington, Ontario

THE Nalco® SYSTEM ... Serving Industry through Practical Applied Science

For more data circle 515 on Post Card

HELPFUL BULLETINS

HEATERS, HEATING

101 Unit Heaters — Catalog B-1523, 26 pp, describes features and advantages of unit heaters for commercial and industrial applications. Details of construction are covered, and typical specifications, application data, selection tables, outline dimensions and maintenance instructions given. Piping and wiring diagrams included. Westinghouse Electric Corp.

102 Overhead Heating Units — Bulletin P 1–57, 16 pp, contains photographic reproductions of overhead gas-fired heaters, as installed in a wide variety of commercial and industrial plants. How this type of heating was used to solve specific heating problems is detailed. Prat-Daniel Corp.

103 Steam Heating Coils — Catalog 1710, 26 pp, contains pictures and descriptions of commercial and industrial steam heating coils. Gives information on features, construction details and applications, and provides piping diagrams and many performance and selection tables, as well as other data. Sturtevant Div., Westinghouse Electric Corp.

VALVES, TRAPS, STRAINERS

104 Regulating Valve — Catalog 307, 6 pp, describes company's Series 30 control valves, for control of all types of fluids. Balanced, tight-closing, single-seated features are fully detailed and flow characteristics are charted. A table of dimensions and weights, and sizing data are included. Schade Valve Mfg. Co.

105 Bronze, Iron Valves — Profusely illustrated, 136-pp Catalog 57 includes recent additions to company's line — renewable seat ring bronze gate valves, composition disc bronze swing check valves and solder end globe valves with drain. An important modification of the 125-lb iron body gate valves — through-port design to reduce turbulence and pressure drop in flow through valves — is illustrated. Technical data for piping layouts are included, as well as a table of equivalent resistance of valves, fittings, and bends, and charts for the rational solution of pressure drop for liquids, gases, and steam. Available to qualified power engineers; please state your job title when requesting this. The Fairbanks Co.

106 Diaphragm Valves — Bulletin 800 contains specifications and dimensions on company's diaphragm valves for pressure and vacuum service. Typical flow characteristics and water capacities are indicated. W. S. Rockwell Co.

107 Eccentric Plug Valves — Catalog 54 describes advantages and design features of easy-operating plug valves which combine an eccentric-shaped plug and an eccentric raised-seat in the valve body. Dimensional data and selection information is included, as well as photos and diagrams of valve features and curves to show frictional resistance to flow of water. DeZurik Corp.

108 — For Lubricated Plug Valves — This 12-pp illustrated manual covers function of lubricants in lubricated plug valves and essential properties of an effective lubricant. Detailed information on how to select the right lubricant and how to apply it is presented in text and pictures. Charts list flow materials which plug valves service, recommended lubricant number, service range and temperature range. Walworth Co.

109 — Compressed Air Valve — This 6-pp bulletin describes features and advantages of company's safety valve for compressed air, designed to safeguard against unnecessary accidents. Installation instructions and design data are included. Sands Safety Valve Co.

110 Cushioned Valves — Bulletin G-5 describes and shows, schematically, various piping arrangements for particular applications, such as supply water to mill, accurate water level control in reservoirs, emergency fire protection, and isolating part or all of a system. Golden-Anderson Valve Specialty Co.

111 Steam Trap — Six-pp Bulletin AD-2261 explains how an inverted open float steam trap works to remove condensate and keep steam lines hot and dry. Includes tables and instructions for selecting traps for any condensate discharge condition. Also included are a diagram and recommendations for proper installation, as well as a table of dimensions. Crane Co.

112 Liquid Strainer — Self-cleaning liquid strainers designed for the straining of fluids without interrupting flow for cleaning the screen are described in Bulletin W-68C. Dimensions are tabulated and diagrams of manual operation and motor driven units shown, with appropriate listing of component parts. Golden-Anderson Valve Specialty Co.

EQUIPMENT PROTECTION

113 Aluminum Jacketing — Bulletin 530a describes company's line of aluminum weather-proof jacketing for insulated lines, towers, vessels and tanks. Application procedures are pictured and suggested specifications offered. Childers Mfg. Co.

114 Pipe Coating, Wrapping — Company's facilities for coating and wrapping pipe are described in this 8-pp bulletin. Drawings illustrate various stages in the wrapping process, and a description is given of the Holiday detection test and other controls for assuring that pipe is evenly coated and protected. Southern Pipe Coating Co.

MECHANICAL POWER TRANSMISSION

115 Power-Safe Brakes — The illustrated story of company's newest electric brake designed for fail-safe applications is told in this 36-pp technical report. Catalog features detailed descriptions of component parts and includes photos, drawings, diagrams, as well as an illustrated explanation of operation, selection factors, torque characteristics and controls. Warner Electric Brake & Clutch Co.

116 Flexible Cushion Coupling — Bulletin A669, 12 pp, describes the Paraflex, a flexible cushion coupling, designed to automatically compensate for all combinations of misalignment and end float. Cutaway views and drawings are included, as well as coupling selection data and a table listing service factors for couplings. Dodge Mfg. Corp.

117 Drive Selector — Catalog GEN-169 is a slide-rule-type plastic device designed to assist in selecting proper motor, control panel, and operator's station of a general-purpose Thymotrol adjustable speed drive. Covers both fractional and integral drives up to 3 hp. By setting slide at desired horsepower, appropriate ratings, frame sizes, dimensions, and model numbers can be rapidly determined. Standard and optional features, performance characteristics and ordering data given. General Electric Co.

118 Power Transmission Data — This 1957 handbook provides 186 pp of power transmission data compiled and revised to meet modern engineering standards and tabulations, and calculated to plan proper transmission for any drive. Gear section tabulates dimensions on standard spur, bevel, spiral, helical, worm gears and steel rack. Speed reducer section gives specifications, dimensions and vital mechanical information necessary to select proper reducer in relation to required ratios, horsepower, torque and installation dimensions. The Ohio Gear Co.

New and revised publications reviewed on these pages offer help on operating and maintenance problems. To order, use the handy Reader Service Cards provided on pages 105 and 106.

119 Geared Flexible Couplings — Book 2775, 12 pp, details pertinent application and selection data for couplings with maximum bores ranging up to 7 in. and ratings from 2½ to 572 hp per 100 rpm. Describes four basic applications and includes cutaway views and drawings illustrating features. Link-Belt Co.

ELECTRICAL

120 Package Unit Substation — This 8-pp bulletin explains advantages substations offer when used in modern electrical systems, and shows a complete line of company's equipment designed to meet modern electrical system needs. Both high and low voltage components are covered. Square D Co.

121 Protected Transformers — Construction and design features of self-protecting transformers in ratings 3 kva through 100 kva, 15 kv and below, are covered in 8-pp Bulletin 61 B 7309C. Tells how transformers, which are self-protecting against lightning, overloads and short circuits, improve service continuity, reduce operating and maintenance costs. Allis-Chalmers Mfg. Co.

122 Time Meters — Bulletin GEA-6710 describes advantages and typical applications of company's electric time meters, featuring an extra digit for wider range of measurement. Price information and dimensional diagrams are included. General Electric Co.

123 Contact Meter-Relays — Details on automatic control with contact meter-relays are featured in 40-pp Catalog 4D. In addition to an illustrated description of construction and operation, it includes a detailed section on circuitry and price and specification information on the various relays. Catalog is illustrated with photos and diagrams, and contains actual size dial areas and typical scale arcs. Assembly Products, Inc.

124 Panel Meters — This 16-pp catalog describes panel meters designed to meet JAN-1-6 and MIL-M-6B specifications. Gives dimensions and performance data for D'Arsonval-type ammeters, millivoltmeters, and voltmeters as well as a-c rectifier-type microammeters, milliammeters, and voltmeters. Information on custom meters is included. Waters Mfg., Inc.

125 Power, and Lighting Cable — Bulletin RR-10 describes company's Type RR cable for power and lighting service. Technical characteristics of direct buried, aerial or conduit installations and sheaths are included, as well as tabular data giving physical dimensions. Triangle Conduit Co., Inc.

126 Magnetic Starters — Bulletin GEA-6611, 20 pp, contains comprehensive data on company's magnetic motor starters for such applications as pumps, hoists, blowers, saws, fans, mixers, compressors, motor control center, others. Such advantages as fast installation, simplified wiring, easy inspection and maintenance, long life, dependable operation and maximum flexibility are covered, and dimensions given. General Electric Co.

127 Horizontal-Break Switches — Bulletin PSE4, 12 pp, describes outdoor, group operated, horizontal-break switches, illustrating special features which make the two-insulator switches an economical and practical answer to many switching problems. Photos, drawings, mounting details and dimensional data are included. Line Material Industries, McGraw-Edison Co.

128 Low-Voltage Capacitor — Twelve-pp Bulletin GEC-1331A describes low-voltage industrial capacitors for indoor or outdoor shunt application. Lists ratings, weights and dimensions of capacitor units and equipments, and includes diagrams and pictures. General Electric Co.

129 Terminals and Connectors — Bulletin S7, 12 pp, describes company's pressure terminals and connectors available in pocket-size packages. Lists various connector dimensions, and includes actual-size outline drawings of each. The Thomas & Betts Co.

130 Battery Users Manual — Motive-power battery maintenance and repair is detailed in this revised edition of company's Battery Users Manual (Bulletin GB-1599A), 44 pp. Developed as a result of in-plant training courses, this book is designed to enable power engineers to conduct an organized battery training course in their own plants. Encompassing maintenance, repair and selection, this reference book includes over 60 photos, diagrams and tables to review battery theory and construction, demonstrate proper selection, illustrate charging method and equipment, demonstrate testing, and present correct battery room layout. Gould-National Batteries, Inc.

131 Accessories for Reclosers — Sixteen-pp Bulletin CR1CA provides information on the complete line of Kyle Type R and W reclosers. Application, operation, features, and ratings of the various devices are covered, and typical control schemes are included. Line Material Industries.

132 Carbon Brushes — Getting best performance from carbon brushes is theme of 8-pp Bulletin GEA-6688. Question-and-answer style covers brush life, metal transfer, commutator threading, bar marking, commutator adjustment and other information. General Electric Co.

Good Tips On Welding Equipment, Procedures

133 How to Weld Stainless — "A Guide to Better Welding of Stainless Steels" is a 20-pp pocket-size booklet intended for both the novice and experienced welder. Presented in question-and-answer form, it is illustrated with drawings and close-up photos to clarify both problems and solutions. Arcos Corp.

134 Repair, Fabrication Welding — This 52-pp reference manual covers recommended practice for repair welding and fabrication welding of steel castings. The result of a research project of Battelle Memorial Institute and Steel Foundry Research Foundation, it describes welding methods — including preparation for welding, effects of welding, and the welding operation — and includes a section on electrode classification and weld-metal properties. Additional sections cover trade names and manufacturers of all classes of electrodes and procedures for welding specific castings. Tempil Corp.

135 Electrode Guide — Among the many helpful features of 70-pp pocket-size Catalog 1318, is an electrode consumption calculator, which tabulates data for calculating consumption per linear foot in welding of various types of joints. Describes each electrode, its color code, its application, and best procedure for use in welding. Weld metal chemical analyses and mechanical properties are fully explored. Such related information as the factors which determine electrode selection, specifications for filler metals, and testing of deposited weld metal is also discussed. Air Reduction Co., Inc.

BOILERS, BURNERS

136 Packaged Boilers — Bulletin 1245 describes company's packaged automatic boilers for steam or hot water heating and hot water service. Detailed illustrations of both oil and gas fired units are included, as well as tables of dimensions, weights. Orr & Sembower, Inc.

137 Industrial Burners — Twelve-pp Bulletin FC-57 describes features and advantages of company's packaged industrial burners for gas or oil or combination firing. Combustion performance details are charted, and photos and drawings of typical installations included. Coen Co.

INSTRUMENTS AND CONTROLS

139 Central Station Control — Bulletin 1032, 12 pp, describes the application of automatic control systems to large central station boilers. Using a typical station as an example, the bulletin explains operation of the combustion, feedwater, feed-pump and soot-blowing control systems. A schematic diagram shows how the individual components are integrated into complete supervisory systems. Copes-Vulcan Div., Blaw-Knox Co.

140 Thermostat Accessories — A variety of modern accessories for electric thermostats and limit controls are described in Bulletin RT-819. Contains detailed drawings and diagrams of available thermostat cases, devices for adjusting temperature controls, mounting brackets and stuffing boxes. Robertshaw-Fulton Controls Co.

141 Meter and Control — Publication 54-766, 8 pp, describes the Veriflow, which meters, indicates and totalizes liquids, such as water, molasses, sulphuric acid, coal tar, etc., using the positive displacement principle, and the Veritrol, which controls material being metered. Principle, construction, operation and features of both meter and controller are explained. The Hays Corp.

142 Flow Tube — An impact-type head meter (differential producer) for accurate measurement and regulation of fluid flow is described in 6-pp Bulletin FT. Advantages are listed, and typical installation photos, cross section drawings and performance data are included. Foster Engineering Co.

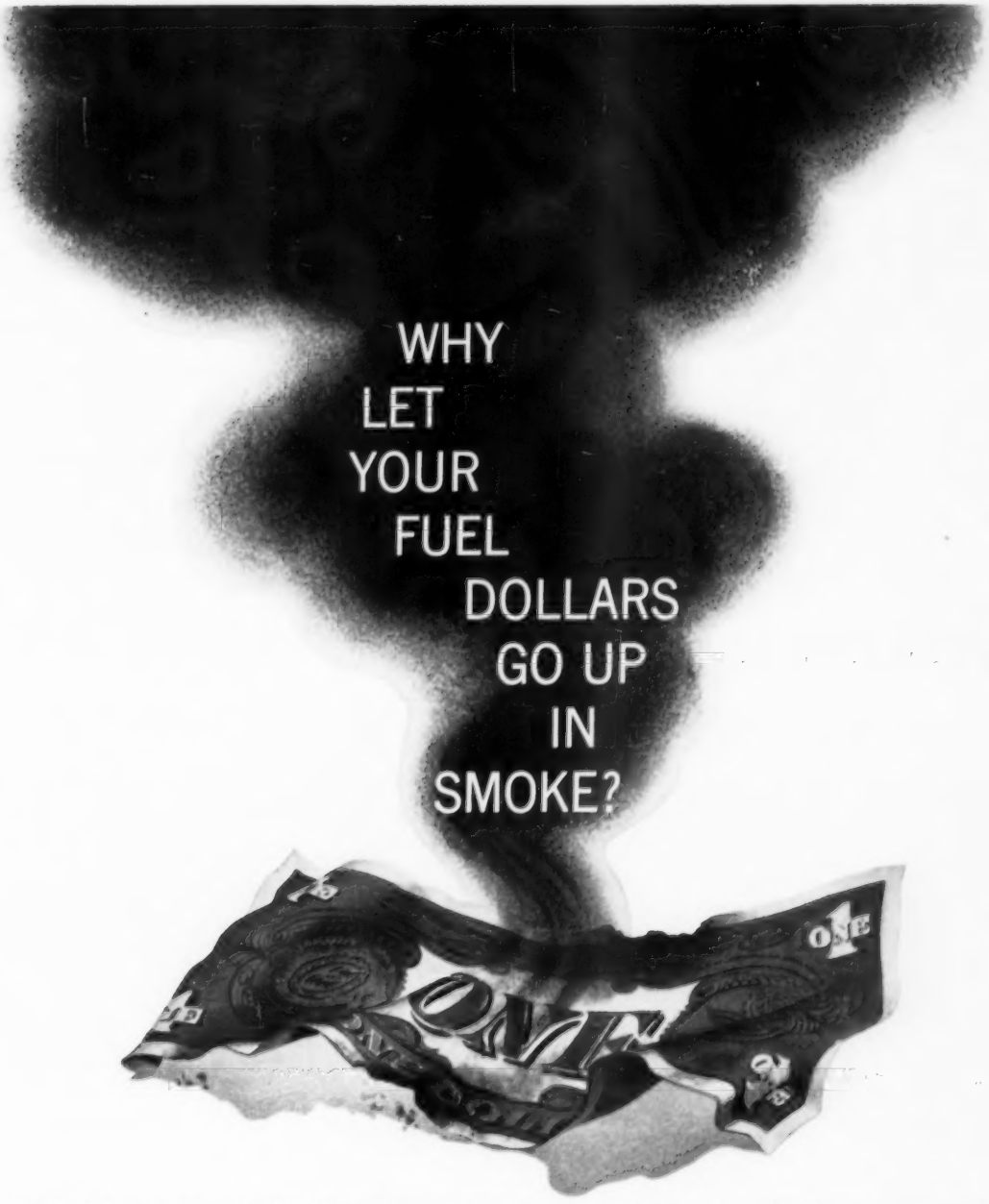
143 Boiler Safety Controls — Bulletin L-711, 24 pp, covers basic safety controls for low pressure steam boilers. Simple diagrams and explanations tell the "why" and "how" of all authoritative methods of providing maximum safety and automatic water level control for all low pressure steam boilers. McDonnell & Miller, Inc.

144 Regulator-Filter-Lube — Bulletin 80, 12 pp, describes a packaged unit for compressed air operations, which regulates to desired pressure, filters water and dirt from the air line and lubricates the air stream with a fine fog-like oil mist. Specifications for the various types in the line are included, as well as photos, drawings and diagrams. Perfecting Service Co.

HOSE AND TUBING

145 Metal Hose Products — Catalog ID-100A, 12 pp, describes flexible metal hose for conveying gases, solids and fluids under high temperature, pressure and vacuum conditions. Complete specification data is included, as well as photos and drawings illustrating design and construction features of the flexible metal hose. Universal Metal Hose Co.

146 Seamless Mechanical Tubing — Bulletin TB-340A, 8 pp, explains cost and time-saving benefits of seamless mechanical tubing over other forms of stock. Included are descriptions of how seamless tubing is manufactured and finished, and



Packaged Ljungstrom® Preheaters increase efficiency for boilers as small as 25,000 lbs per hour! Money spent on fuel in a single year often equals the cost of the boiler itself! And with fuel prices continually rising, every BTU is doubly precious.

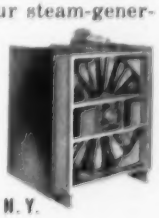
So don't let fuel dollars go up the stack—in smoke. Whether your boiler produces 25,000 or 250,000 pounds of steam per hour, the shop-assembled Ljungstrom preheater recovers heat—and dollars. Results: FUEL CONSUMPTION IS REDUCED! Generally 10% or more. This will usually write off the cost of a Ljungstrom in less than 2 years.

BOILER PRODUCTION IS INCREASED! By preheating air, higher temperatures in the furnace are assured, higher heat absorption and steam producing capacity are made possible.

LESS MAINTENANCE NEEDED! Improved combustion means less slag, cleaner stack gases. Thus you benefit from fewer overhauls; longer service between shutdowns.

LOW GRADE FUELS PRACTICAL! Higher furnace temperatures permit effective burning of very low grade fuels.

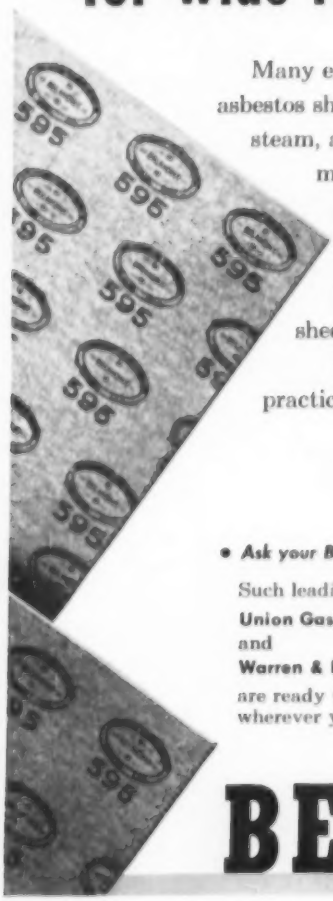
COMES READY TO INSTALL! The Ljungstrom is shop-assembled, is easily applied to your steam-generating units. For details, contact The Air Preheater Corporation today. Ask for our free brochure.



The Air Preheater Corporation, 60 EAST 42ND STREET, NEW YORK 17, N. Y.

For more data circle 516 on Post Card

VERSATILE sheet packing for wide range of service



Many engineers call Belmont's compressed asbestos sheet packings for dry and saturated steam, air, gas, oil, solvents, ammonia and most chemicals—"the handiest sheet packings in the plant."

Various compositions and special binders, all thicknesses 1/64" to 3/16", sheet sizes to 150" x 150", or supplied as cut gaskets to specifications, for practically all maintenance requirements.

The Belmont Packing and Rubber Co.
Butler & Sepviva Sts., Phila. 37, Pa.

• ***Ask your Belmont Distributor for his recommendations.***

Such leading Packing Distributors as:
Union Gasket & Packing Co., in Denver, Colorado
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are ready to serve you promptly and helpfully, wherever you are.

BELMONT

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differences in dimensional tolerances, costs, machinability and surface finishes of various types of seamless tubing. Tubular Products Div., The Babcock & Wilcox Co.

147 Stress Rupture Data — Power engineers concerned with equipment involving use of tubular products at elevated temperatures and pressures will be interested in data contained in Bulletin TDC-153B. Furnishes results of stress rupture tests on 14 steels including carbon steel, several alloy steels and 10 different stainless steels. Tubular Products Div., The Babcock & Wilcox Co.

PUMPS, COMPRESSORS

148 General Service Pumps — Catalog D-100 describes four types of general service pumps, designed for hot and cold water and brine circulation, air conditioning systems, sprinkler systems, boiler feeding, pressure boosting and washing machinery. Cutaway drawings, performance data, and specifications included. C. H. Wheeler Mfg. Co.

149 Sealless Pumps — Eight-pp Catalog 10.0 features technical data and material selection information on Flex-i-liner sealless plastic and stainless steel pumps. Performance data with pump characteristic curves and charts, capacities, operating pressure ranges, and other information are included. Vanton Pump & Equipment Corp.

150 Vertical Non-Clog Pumps — Catalog F-100 describes advantages of company's vertical non-clog pumps, for sewage disposal, underpass service and drainage, and for applications in reduction plants and paper mills. Three dry pit installations are shown, and a cutaway drawing shows mechanical features. C. H. Wheeler Mfg. Co.

151 Air and Vacuum Pumps — Sixteen-pp Catalog 757 describes rotary positive air and vacuum pumps, gas boosters and air motors. Gives details of construction, dimensions, capacities, performance curves. Leiman Bros., Inc.

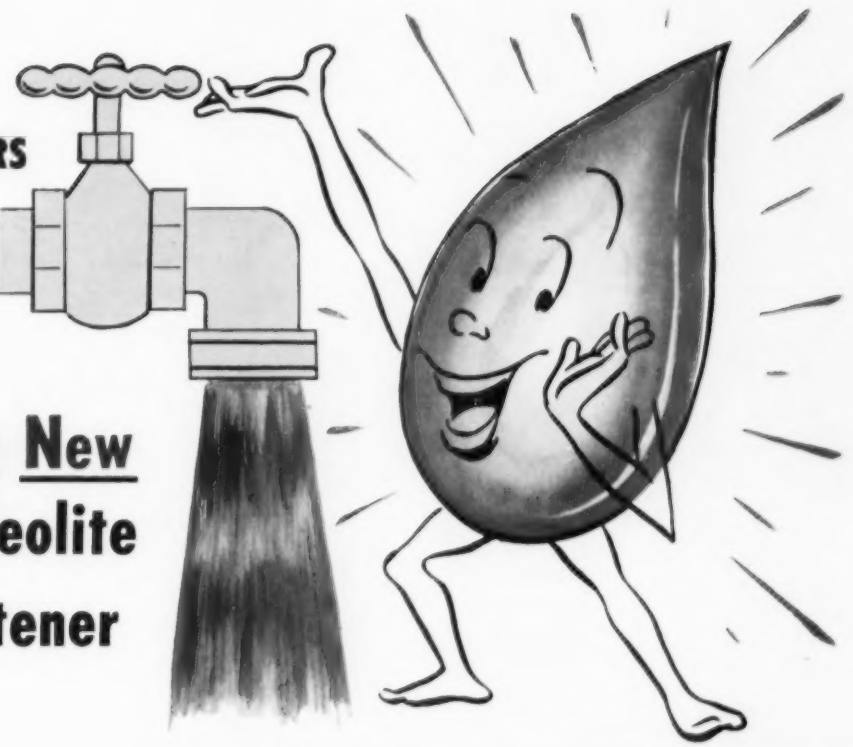
152 Rotary Air Compressor — Eight-pp Bulletin P-106B describes company's 600 rotary air compressor. Photos and close-up views illustrate design and construction features, and general specifications are included. Le Roi Div., Westinghouse Air Brake Co.

Bulletins reviewed here are offered primarily for qualified power engineers. Manufacturers may withhold literature from persons who do not state their job title and company. Some manufacturers also prefer not to send literature to those in foreign countries in which they have no sales representatives.

153 Air Compression for Industry — This is a 24-pp combination data book and catalog on all types of air compressors from ½ hp to 20 hp. Discusses factors to be considered in use of air for each operation, and points out importance of determining how much usable air is needed, not just the theoretical rating of the compressor. Engineering data charts are included. The Wayne Pump Co.

ALLIS-CHALMERS

Water Conditioning



Announcing New Industrial Zeolite Water Softener

Basic standard water softener designs easily adapted to meet individual plant requirements.

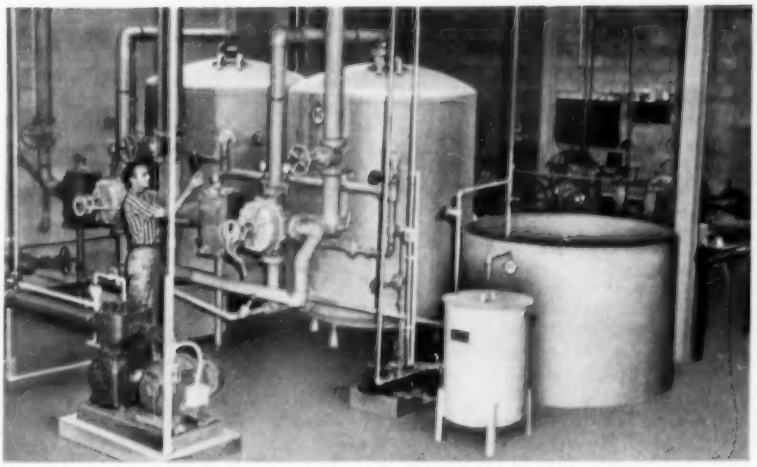
Here's a well-engineered, well-built answer to a wide range of water conditioning problems. It's designed to eliminate costly maintenance due to scaling of pipes and heat exchange tubes; to produce chemically suitable water for drying, paper making, textiles; and to provide water for food processing and many special industrial applications.

Easy Operation

The unit is basically simple. It is engineered to operate with little or no maintenance between regenerating cycles. Regeneration is an easy procedure. Automatic controls are also available to further simplify the operation if desired.

Standard Basic Design

Allis-Chalmers engineers started with a basic standard design developed from years of research and experience.



Allis-Chalmers sodium zeolite water softener installed in Ohio dye plant.

From this, a water softener is engineered to meet your individual plant requirements. Such factors as size of softener tank, size of salt and brine tank can be varied to meet your conditions.

Get Details

For complete details about Allis-Chalmers industrial type zeolite water softeners, call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-5552

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DOUBLE BOILER BLOW-OFF SAFETY

1

Quick-Operating
EVERLASTING
Straight-Through Valve

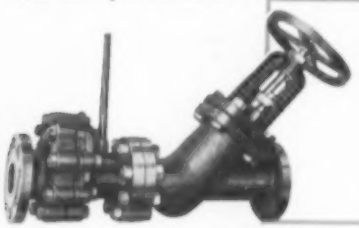
The standard Everlasting design which opens with a quarter-turn of the lever and closes with a drop-tight seal that actually improves with use.

2

Shock-Resisting
EVERLASTING
Angle Valve

Specially designed and stoutly constructed to withstand severe service and the shocks and abrasion of blow-down solids.

Conform with ASME codes. Available in a range of sizes for pressures up to 600 psig. *Write for descriptive bulletin.*



EVERLASTING DUPLEX UNITS

also available with Y Valves and in any combination of Quick-Operating, Angle and Y Valves.

For "everlasting" service, use

EVERLASTING *Valves*

EVERLASTING VALVE CO.
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OTHER EQUIPMENT

154 Water Control Gates — Sixteen-pp Bulletin 163 outlines the several basic types of gates and their applications. Discharge curves are shown for preliminary sizing, and general specifications are included. Sectional drawings, standard dimensions and field photos provide information on design characteristics and general construction. S. Morgan Smith Co.

155 Insulation Chart — This selector chart covers electrical insulation materials in the A, B, and H temperature classes. Over 30 types are described. Product descriptions cover base materials used, suggested applications, temperature class and available finishes. Gage, type of backing, tensile and dielectric strength and specifications are given for each material. Electro-Technical Products Div., Sun Chemical Corp.

156 On Demineralizers — Bulletin 108-A, 8 pp, features a step-by-step explanation, including formulas, for the "run" of demineralization and the regeneration process. Internal arrangements and operation of basic types of demineralizers for varying water requirements are covered, and types of valve and control arrangements are discussed. Flow chart drawings included in the bulletin. L & A Water Softener Co.

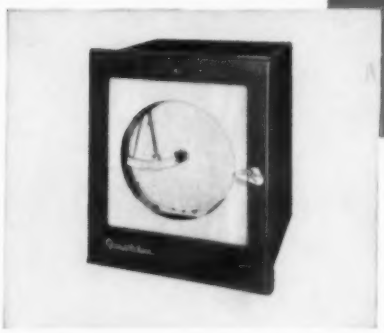
157 Stationary Diesels — Eight-pp Bulletin 111 describes advantages and construction features of stationary diesels designed for continuous service, high efficiency and easy accessibility for maintenance. Construction features are illustrated, and specifications and performance curves included. White Diesel Engine Div., The White Motor Co.

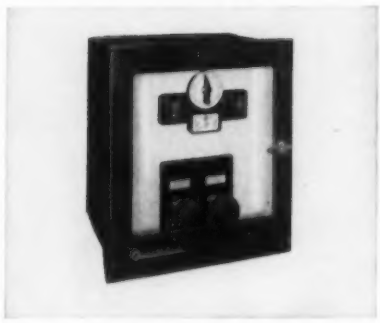
158 Dust, Fume Eliminators — Catalog VRU-4-57, 8 pp, describes Centri-Merge vertical rotor type dust and fume eliminators, telling how they operate, and giving operating advantages and maintenance features. Capacities and dimensions are shown for both manual cleanout and conveyor cleanout designs. Schmieg Industries Inc.

159 PVC Blowers and Fans — Advantages of un-plasticized rigid polyvinyl chloride blowers and fans for exhausting corrosive air, fumes and gases are detailed in this illustrated bulletin. Physical properties of polyvinyl chloride are tabulated. An insert sheet describes other PVC products. Industrial Plastic Fabricators Inc.

160 Bucket Elevators — Comparison of elevator types and selection of bucket elevators for a variety of applications are covered in 80-pp Catalog be-55. Specifications and dimensions for centrifugal discharge, perfect discharge, contin-

Quantichem automatic analyzers for total water hardness and dissolved silica concentrations include the electronic colorimetric unit and the recorder. These analyzers are especially important in the operation of water treating facilities for high-pressure steam power plants.





Automatically analyze water for silica and total hardness

...with the field-proven Quantichem instrument

All the steps of an analysis . . . from the flushing of sample cells and calibration of photoelectric measuring circuit to the metering of reagents and the recording of results . . . are performed by the new Milton Roy Quantichem instrument. This automatic analyzer is, in fact, a miniature lab for analyzing water for total hardness or silica content. Units are now in actual customer use after more than three years of research and field testing.

The silica analyzer has a range of 0 to 0.05 ppm . . . standard ranges for the total hardness analyzers are 0-3 and 0-5 ppm. Concentrations of other constituents in water, such as iron and phosphates, can also be analyzed by this unit. For these and other applications of this analyzer, consult our instrument engineers. Bulletin 1156 contains detailed information on the Quantichem instrument . . . write for your copy.

Suncoast Instrument Division, MILTON ROY COMPANY,
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CHEMICAL INSTRUMENTATION SYSTEMS

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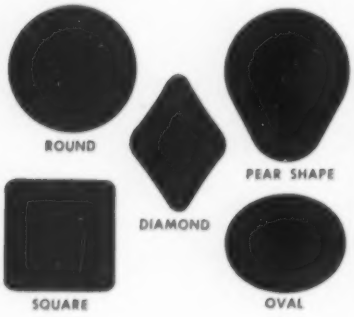
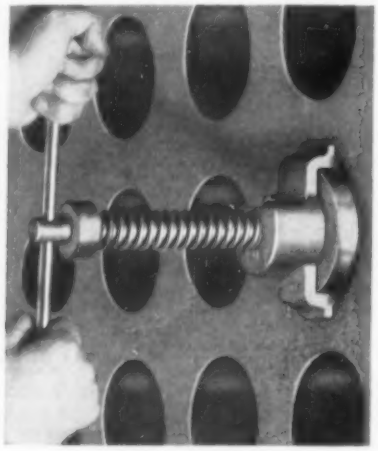
ROTO *Hand Hole* Seat Scraper

Eliminates Dirty, Tedious Work

Here is a simple, hand-operated tool for cleaning inside caps on boilers that will pay for itself many times over. This tool is equipped with retractable knives mounted on a revolving spindle having a bearing within a substantial yoke. An adjustable spring automatically maintains tension on the knives, sufficient to remove all foreign matter but not enough to cut the metal. A few turns to the right, and the job is done. A half turn to the left releases the tool. Try a Roto Seat Scraper and you'll wonder how you ever got along without one.

These are some of the hand hole shapes cleaned with a Roto Seat Scraper. Various sizes available.





Illustrating ease of operation of Roto Hand-hole Seat Scraper.

Roto Hand-hole Seat Scraper for B & W Boiler.

What Users Say—

It did a fine job. Completed the work in 80% less time.
(Engineer, Chemical Plant)

Roto Seat Scraper has paid for itself many times over on our Keeler Boiler.
(Supt., Public Utility)

One man cleaned inside cap seats on boiler header in 4 hours. Formerly took 2 men 3 days.
(Pennsylvania Manufacturer)

We also make a Reseating Machine for cleaning outside caps to assure a smooth, true fit. Send for details.

SEND FOR BULLETIN

ELLIOTT COMPANY — ROTO PLANT
DIVISION OF CARRIER CORPORATION
Tube Cleaner Specialists Since 1910

147 Sussex Avenue, Newark, N. J.

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nous bucket, gravity discharge, elevator-conveyors, pivoted bucket carrier, bulk cement systems, and marine legs are included, as well as supplementary information on the elevator-lowerator, vertical arm elevator, buckets, bucket punching, mounting of buckets, belt splicing, other factors. Webster Mfg., Ins.

161 Maintenance, Other Equipment — Catalog 31 includes 64 pp of information for selecting and ordering metal-working tools, motor and generator maintenance equipment, flexible shaft machines, safety equipment, electrical and mechanical maintenance products. Profusely illustrated with photos and detail drawings, catalog covers standard items, including rotary burs and files, metal-cutting saws, mica undercutters, field coil testers, growlers, test instruments, others. Martindale Electric Co.

162 Centrifugal Ventilator — Twelve-pp Bulletin SDA-220 contains features, construction details, ratings, performance data and dimensions on both the belt drive and direct drive roof ventilators. Recommended specifications are discussed, and numerous photos, line drawings, tables, charts and graphs included. The Peerless Electric Co.

163 Standpipe and Hose — Inspection, maintenance and protection of standpipe and inside hose systems is covered in this 8-pp Safety Code. Reviews various services performed by a standpipe and hose system, and provides specific guidance for periodic inspection of system components, as well as instructions for maintenance of hose, couplings, nozzles, and playpipes. Fire Equipment Manufacturers' Association, Inc.

164 Air Filters — Detailed information on filters designed to provide particle-free air for all critical air-cleaning problems is featured in this illustrated bulletin. A filter selection chart is included, as well as data on installation, performance and construction. Flanders Filters Inc.

You'll save time in ordering bulletins by using the Reader Service Cards on page 105. Of course we honor letterhead requests—but it takes us somewhat longer to handle them.

165 Rubber Faced Steel Plate — Advantages of rubber faced steel plate are detailed in 24-pp Catalog MRG-444. Illustrates and explains how abrasion problems in industries handling sand, gravel and concrete were solved by means of rubber faced steel plate, and describes other applications in metalworking, mining, coal handling, grain, seed and soybean, chemical and material handling. The Gates Rubber Co.

166 Trash Rack Rakes — Bulletin 158A describes company's self-dumping trash rack rakes of the log-grapple and regular types. Features and advantages are illustrated with photos and diagrams. S. Morgan Smith Co.

167 Air Conditioning, Distribution — This booklet illustrates and describes the combined application of Electronic temperature controls and Uni-Flo air distributor products. Typical installations are shown. Barber-Colman Co.

Now you can buy a

Bailey-built HEAT PROVER Analyzer

Flue gas analysis with a Bailey HEAT PROVER Analyzer at a furnace stack. Per cent oxygen and combustibles is shown continuously.

CONTINUOUS READINGS OF OXYGEN AND COMBUSTIBLES

The famous Cities Service HEAT PROVER Analyzer, formerly available only on loan, is now manufactured by Bailey Meter Company, and you can buy one outright. With this handy portable instrument, you can easily monitor the per cent of oxygen and combustibles in gases.

The continuous readings from a Bailey HEAT PROVER Analyzer enable furnace, kiln, and engine operators to correct combustion variables before costly losses are incurred. Although it weighs a scant 25 pounds, the HEAT PROVER Analyzer is the key to maximum combustion efficiency. With it, the operator can determine the proper proportion of fuel to air at any time.

The two meters on the analyzer show per cent by volume of oxygen and combustibles on either a 20% range span or a more sensitive 4% range. Temperature of flue gases in degrees Fahrenheit is also shown.

Compared with involved, time-consuming Orsat measurements of flue gases, this new portable analyzer offers these advantages:

1. Simultaneous direct readings of oxygen and combustibles.
2. Negligible time lag between combustion change and reading change.
3. Continuous sampling, analysis, and readings.
4. Convenient measurement of temperature.

Ask your Bailey engineer how you can use this instrument to increase combustion efficiency. Or, write today for more information on how this new Bailey HEAT PROVER Analyzer can pay for itself practically at once. G-39-1

Instruments and controls for power and process

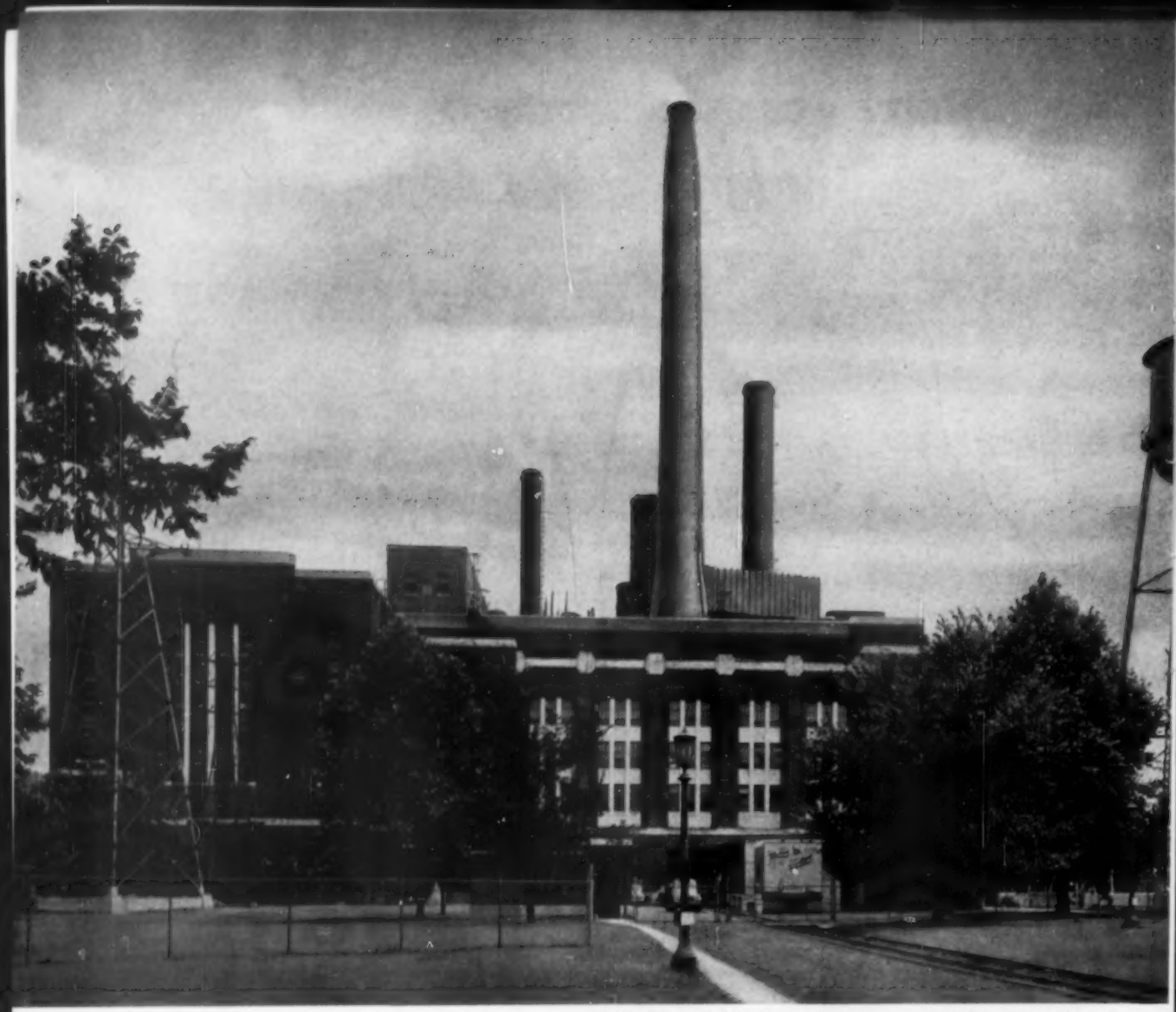
BAILEY METER COMPANY

1040 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

BAILEY METERS

For more data circle 522 on Post Card



Philo Plant of Ohio Power Company on American Gas & Electric System. Stack in front is for the new Supercritical Unit.

B&W's Universal Pressure Steam Generator

Helps Philo Plant Open the Way to New Economies in Steam-Electric Generation

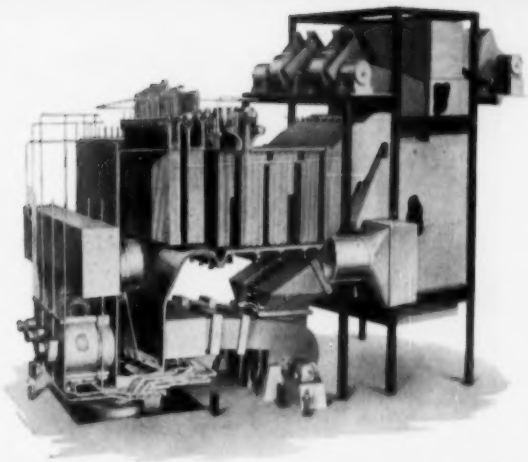
Generating history is being made at the Philo Plant of the Ohio Power Company on the American Gas & Electric System. Here, America's first commercial supercritical pressure steam-electric unit is in operation, probing the frontiers for new economies in the production of energy.

A Symbol of the Vision and progressiveness of America's public utilities and their suppliers, Philo is a landmark in engineering history. It is the result of years of engineering, research, and development that solved the many problems which had stood in the way of greater plant efficiency that comes with the highest possible combination of pressure and temperature.

The Problems Solved included the very difficult ones of feedwater chemistry, of heat transfer and control of internal deposits, metallurgy for higher temperatures combined with higher pressures, and development of control and operating techniques.

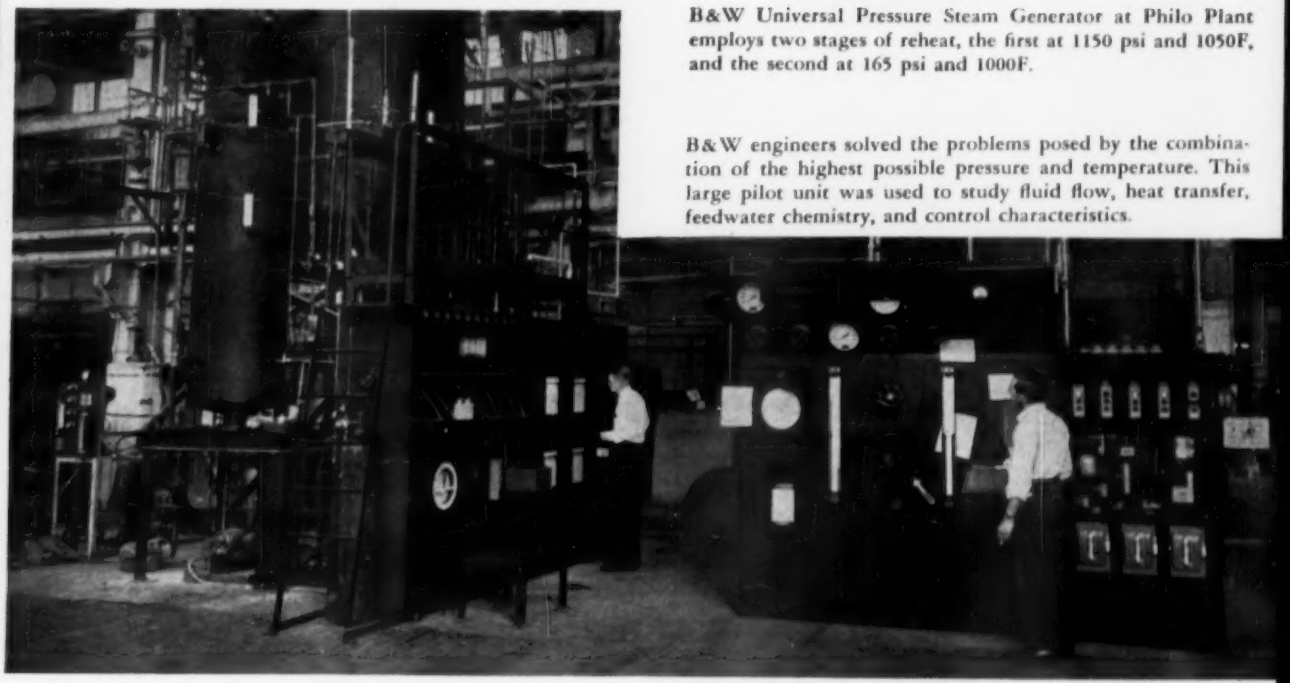
Philo's Supercritical Unit, with a turbo-generator operating at 4500 psi and 1150F, is producing over 120,000 kw, in the same space and using 45 per cent less fuel per kwhr than the 40,000 kw unit it replaced.

Three B&W Cyclone Furnaces assure rapid and complete combustion, with minimum fly ash discharge and maintenance.



B&W Universal Pressure Steam Generator at Philo Plant employs two stages of reheat, the first at 1150 psi and 1050F, and the second at 165 psi and 1000F.

B&W engineers solved the problems posed by the combination of the highest possible pressure and temperature. This large pilot unit was used to study fluid flow, heat transfer, feedwater chemistry, and control characteristics.



Two More B&W Universal Pressure Steam Generators are now being built for The American Gas & Electric System. Together these will produce 900,000 kw—enough to supply residential power for a city of 8,000,000. Like Philo, they will continue to push forward this new frontier in steam generation.

Nearly a Century of B&W leadership in steam generation stands behind these achievements. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

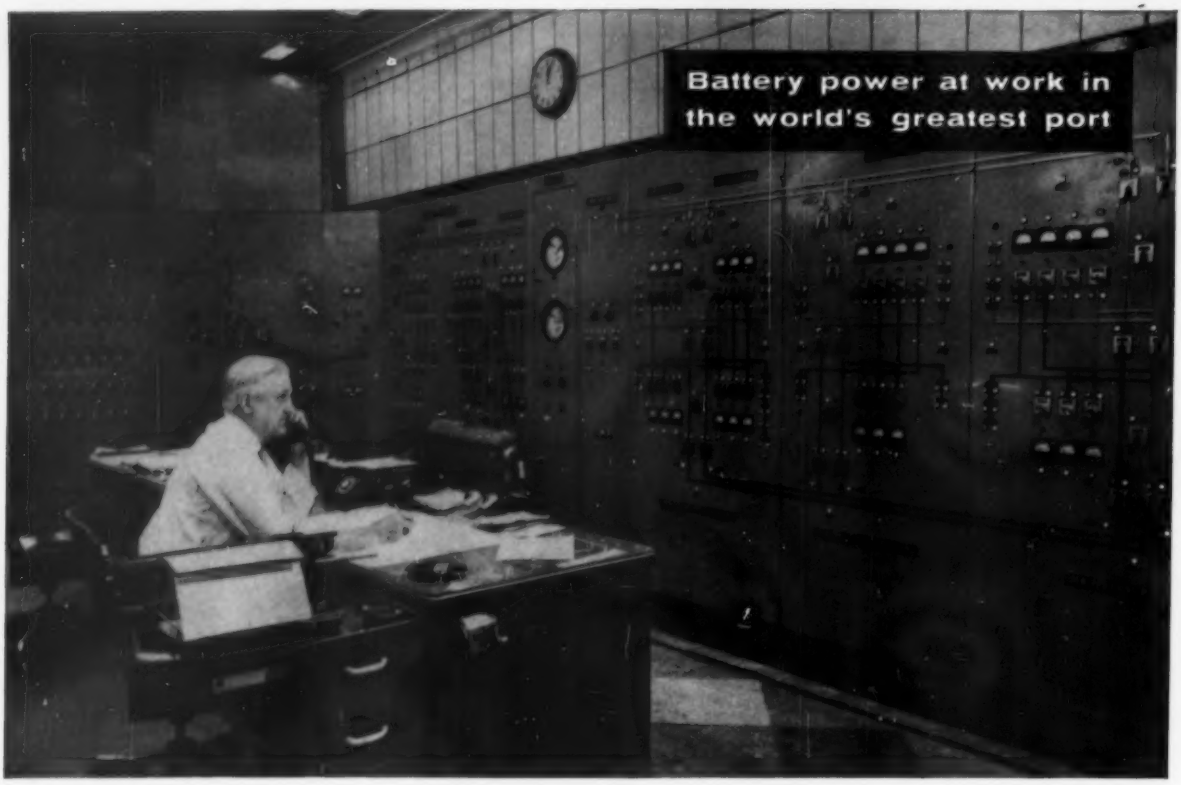
G-833-CS

BABCOCK & WILCOX

BOILER DIVISION

Shop assembly of secondary front wall. Pre-assembly of many components for the Universal Pressure Steam Generator greatly speeded field erection.

For more data circle 523 on Post Card



C&D batteries help ventilate the new South Tube of Lincoln Tunnel

Maintenance superintendent checks specific gravity on a C & D control battery in the Lincoln Tunnel. This battery which supplies emergency standby power for the ventilation system, consists of sixty Type PCL-27 cells with a total of 770 ampere-hours capacity.

Lincoln Tunnel engineer checks Saftee-Vent on another C&D installation of sixty Type PCL-9 PlastiCal Control Cells, which supply power for opening and closing relay switches and for switching back and forth between the New York and New Jersey power feeders.

C&D PlastiCal® powers signals for change of air in artery

Here in the new South Tube of the Lincoln Tunnel, operated by The Port of New York Authority, a change of air is provided every 1½ minutes. To provide emergency standby power to operate the all-important signaling and control equipment regulating the ventilating system, the Port Authority chose C&D *PlastiCal®* batteries.

Longer life with less maintenance. "More battery for the money." This, in short, sums up the reasons why the Port Authority engineers specified long-life C&D *PlastiCal* batteries for the vital ventilation controls in the new South Tube of New York's Lincoln Tunnel. *Engineered for control*, C&D *PlastiCal* batteries incorporate the advanced features of lead-calcium plates . . . virtually doubling battery life. In addition, clear plastic cases give easier maintenance and lead-calcium batteries only have to be watered about *once a year.*

Specify C&D PlastiCal Control Batteries—specifically designed for control, switchgear, and auxiliary power applications. And, they're engineered for lowest lifetime cost.

C&D BATTERIES, INC.
of Conshohocken, Pa.
SINCE 1906
Sales and Service Offices in Principal Cities from Coast to Coast

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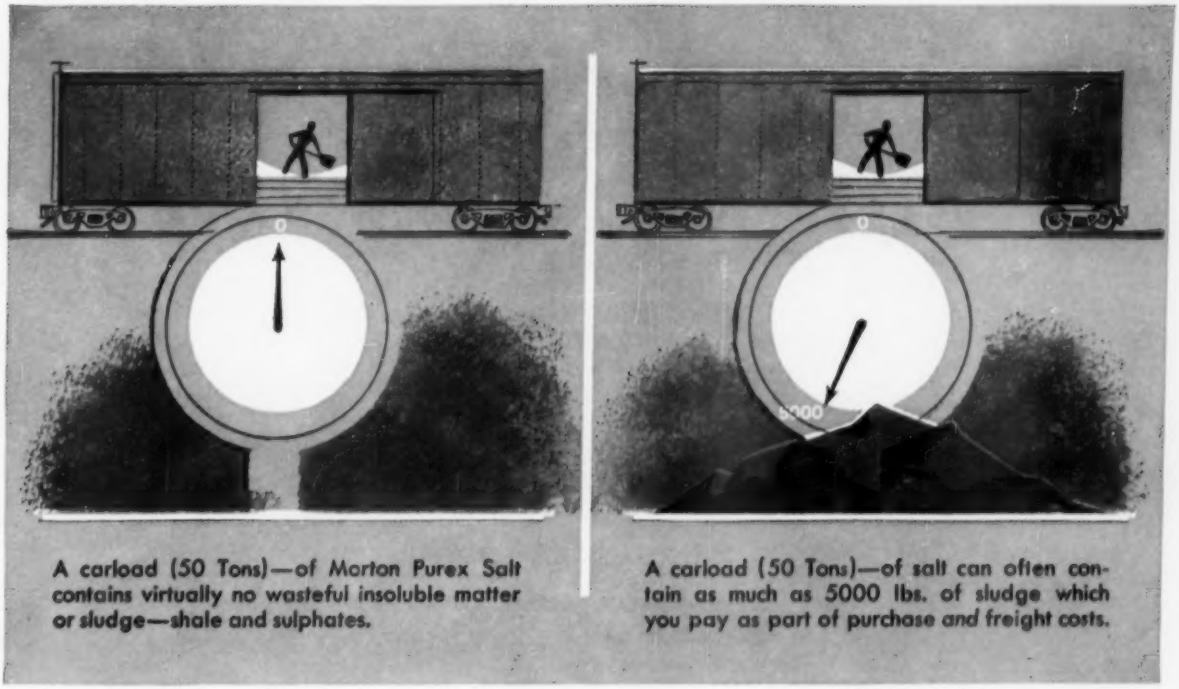
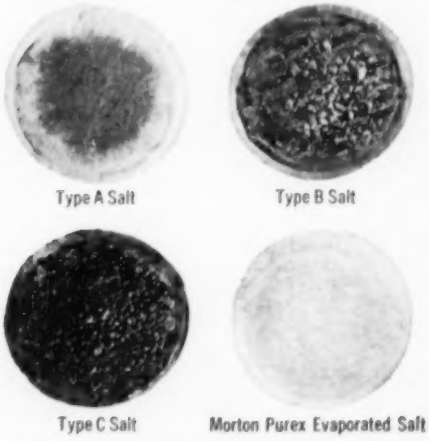


A carload (50 Tons)—of Morton Purex Salt contains virtually no wasteful insoluble matter or sludge—shale and sulphates.

A carload (50 Tons)—of salt can often contain as much as 5000 lbs. of sludge which you pay as part of purchase *and* freight costs.

Stop paying for wasteful sludge —switch to Purex Salt

These filter pads (approximately 1/5 actual size) show you how much insoluble matter (sludge) you get in just 5 lbs. of various kinds of salt.



Type A Salt

Type B Salt

Type C Salt

Morton Purex Evaporated Salt

Tests for insolubles taken from random samples show you that Morton Purex is the only one that contains no wasteful sludge or insolubles.

For more information about Morton Purex Salt, and for free, expert help on any water-softening problem, write:

When you buy Morton Purex Salt, you get high purity evaporated salt that is made in a controlled-particle size to prevent packing and channeling. With Purex, none of your purchase price or freight bill goes toward paying for useless, troublesome insoluble matter.

With Morton Purex, no time or labor is wasted in cleaning out insoluble matter from your brine making system to keep it functioning at peak capacity. For Purex is 100% soluble. Morton Purex will leave no accumulation of material in either brine or water softener tanks. It can be used in wet-storage systems, and in the Morton Model-E Brinemaker.

MORTON SALT COMPANY

INDUSTRIAL DIVISION

Dept. PoE-11, 120 So. LaSalle Street, Chicago 3, Illinois

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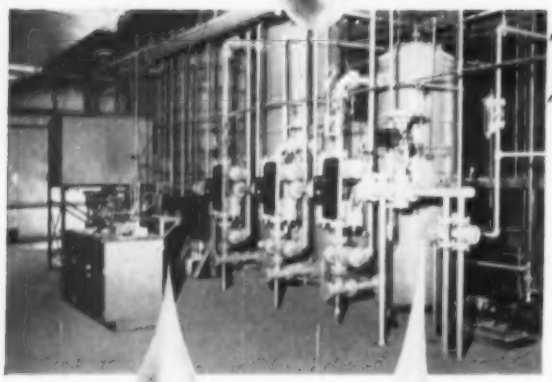
INFILCO

DEMINERALIZATION EQUIPMENT

.....engineered to meet your requirements

MAXIMUM RELIABILITY

HIGHEST QUALITY WATER



Check some of these installations. They are representative of INFILCO's advanced engineering and development in providing water suitable for modern industrial process and power requirements.

Crystal Ice and Cold Storage Company . . . Phoenix, Ariz.
International Paper Company . . . Panama City, Fla.
Helene Curtis Industries . . . Chicago, Ill.
Western Electric Company . . . Chicago, Ill.
National Petro-Chemicals Corp. . . . . Tuscola, Ill.
Hytron Radio & Electronics Company . . . Newburyport, Mass.
Raytheon Manufacturing Company . . . Quincy, Mass.
Hytron Radio & Electronics Company . . . Kalamazoo, Mich.
Minnesota & Ontario Paper Company . . . Internat'l Falls, Minn.
Great Northern Oil Company . . . Roseport, Minn.
International Paper Company . . . Natchez, Miss.
General Tire & Rubber Company . . . Ashtabula, Ohio
Turnsted Division, General Motors Corp. . . . . Columbus, Ohio
Security Engineering Div. Dresser Industries . . . Dallas, Texas

It will pay you to investigate. Write today for Bulletin 1960-C. Inquiries are invited on all water and waste treatment problems, including boiler feed water makeup, process water clarification and purification, waste pollution control, material reclamation and related needs.

INFILCO

INCORPORATED

General Offices • Tucson, Arizona • P.O. Box 5033

Field offices throughout the United States and in foreign countries

THE ONLY COMPANY impartially offering equipment for ALL types of water and waste processing—coagulation, precipitation, sedimentation, flotation, filtration, ion exchange and biological treatment. 5740-12

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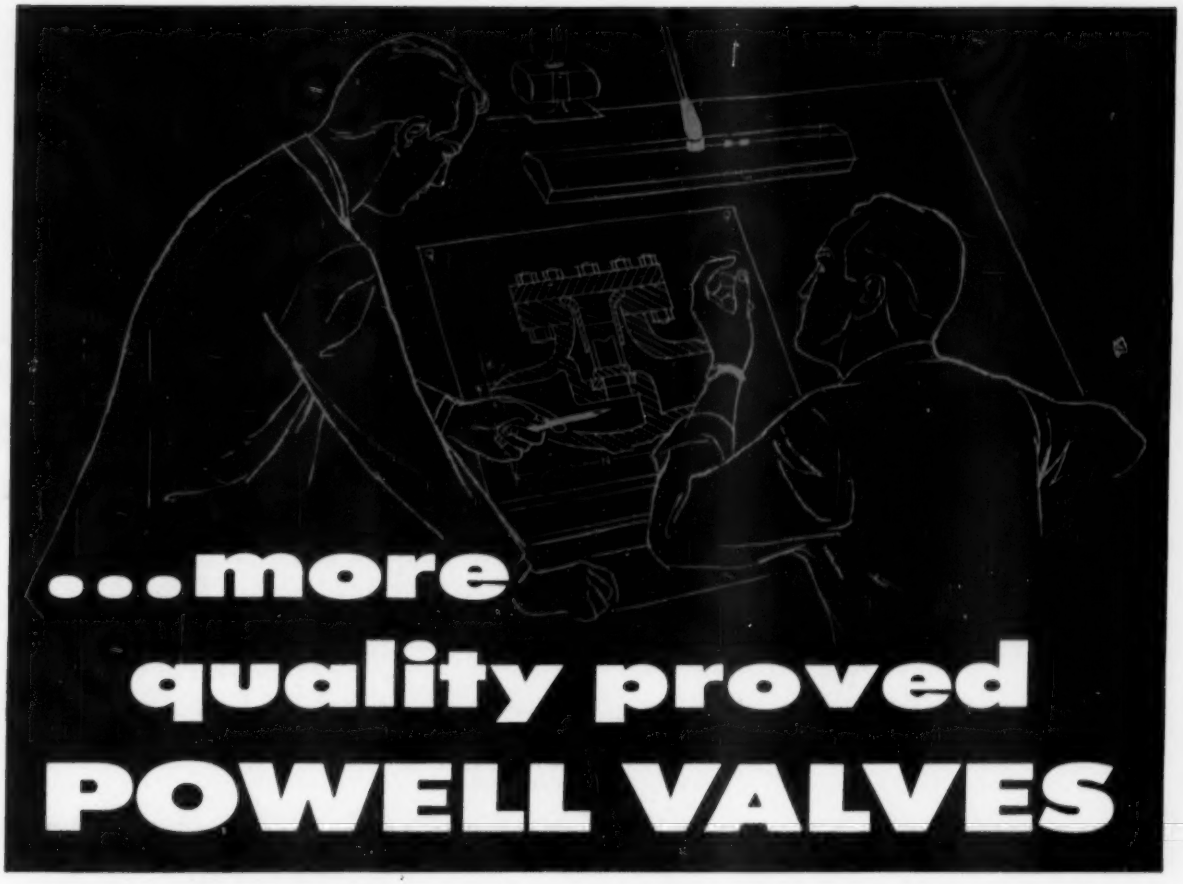


...more quality proved POWELL VALVES

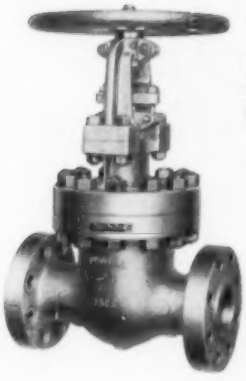


FIG. 1303 SS—1500-Pound Stainless Steel Gate Valve for handling Boiler Feed Water Treating Compound.

FIG. 3061 WE—300-Pound Steel Swing Check Valve.

FIG. 1314 A—1500-Pound Integral Bonnet Steel "Y" Valve.

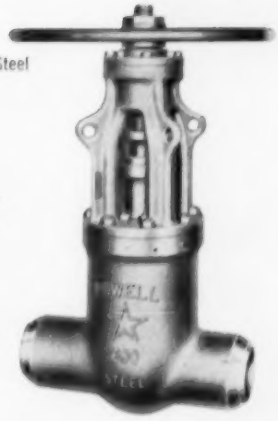


FIG. 16003 WE—600-Pound Steel Pressure Seal Gate Valve.

Designed for long life, designed for dependable service

Consult your Powell Valve distributor for all the facts about quality proved bronze, iron, steel and corrosion-resistant valves. No matter what the flow control problem, a Powell Valve can solve it . . . *better.*

THE WM. POWELL COMPANY, CINCINNATI 22, OHIO . . . 111th YEAR

For more data circle 534 on Post Card

CONSTRUCTION NEWS

Birmingham, Ala. — Alabama Power Co, Alabama Power Co Bldg, has announced that they have been granted permission by the FPC for license to a $121,000,000 project on the Coosa River in Alabama and Georgia. Project involves four dams proposed and the redevelopment of an existing one. Under the new license, the project will have an initial capacity of 360,800 kw, including 81,000 kw already installed at the existing dam. The Commission refused to include under the 50-year license company's Mitchell and Jordan dams, which are already under separate licenses. Five developments of the overall project will include four in Alabama and one in Georgia.

Oakland, Calif. — East Bay Municipal District of Oakland, Calif., has requested permission from the FPC to construct a $63,900,000 power project which would include three dams on the Mokelumne River along its south fork. East Bay project will involve installation of 31,500 kw of generating capacity to be sold in the northern California power market and used by the district in supplying power for pumping water.

Riverside, Calif. — California Electric Power Co, 3771 W Eighth St, has arranged financing in the amount of $7,000,000 through stock issue, proceeds of which will be used in part to pay off short term bank loans incurred with current expansion and construction program, which includes additional generating capacity, power substations, transmission lines and other work.

Norwalk, Conn. — Connecticut Light & Power Co, 36 Pearl St, Hartford, Conn., as previously announced in these columns, had plans under way for the construction of a $25,000,000 power plant on Manresa Island, off the Norwalk shoreline, near here. Actual work on the project was stalemated after denial of company motion to lift existing stay that prevented proceeding with the project. Stay was originally granted because opponents had appealed Public Utilities Commission's action in approving the plant, to the Supreme Court of Errors.

Wilmington, Del. — Northern States Power Co, 100 W Tenth St, has announced projected plans for a major addition to company's Black Dog Generating Plant on the Minnesota River, south of the twin cities of Minnesota and St. Paul. Construction will begin soon and new unit of 150,000 kw will be ready for operation by late 1960, at a reported cost in excess of $25,000,000. Power station at present, has three units with a combined generating capability of 300,000 kw. Company's new investment will bring total outlay at the Black Dog plant to more than $65,000,000.

Tampa, Fla. — Tampa Electric Co, Tampa and Cass Sts, has arranged financing in the amount of $18,000,000, proceeds of which will be used in current expansion program of company plant and system. Work will include larger generating capacity, additional transmission lines and other operating facilities.

Indianapolis, Ind. — Public Service Co of Indiana, Inc, 110 N Illinois St, plans sale of bonds to total about $35,000,000, a considerable portion of fund to be used for extensions and improvements in power plants and systems, including transmission lines, power substations, and other operations for increased electrical output.

Wichita, Kan. — Kansas Gas & Electric Co, 215 N Market St, has approved a major expansion program of company facilities over the next four-year period to cost in excess of $75,000,000. Included in the expansion plan is the construction of a new steam-electric generating plant with an initial capacity of 800,000 kw. The first unit of the new plant, estimated to cost approximately $19,000,000, will have an initial capacity of 165,000 kw and will burn natural gas, with oil as a standby fuel. Work on the new installation will get under way in 1959.

Boston, Mass. — Yankee Atomic Electric Co has plans under way for the construction of a 134,000-kw atomic power plant at an estimated cost of approximately $50,000,000. Plant will be located on a site recently selected for the purpose at Rowe, Mass. Company has petitioned the Massachusetts Department of Public Utilities for authority to issue stock in the amount of $3,000,000 to begin financing of the unit. Yankee Atomic Electric Co is owned by 11 New England public utility companies.

Jackson, Mich. — Consumers Power Co has arranged for disposal of a bond issue in the amount of $35,000,000, fund to be used in current construction program, including increased generating facilities, transmission lines, power substations, and other miscellaneous work. Utility plans to register statement with SEC in regard to offering bond issue to present stockholders.

Fergus Falls, Minn. — State Department of Administration has announced plans for boiler plant rehabilitation at Fergus Falls State Hospital. Work will begin soon at a reported cost in excess of $540,000. G. M. Orr Engineering Co, consulting engineers.

Minneapolis, Minn. — Northern States Power Co has announced the purchase of Wisconsin Hydro-Electric Co, of Amery, Wis., through an exchange of stock and assumption of Wisconsin Hydro's long-term debt and outstanding bank loans. Purchase which involves about $6,000,000 must be approved by the Wisconsin Hydro's stockholders, the Wisconsin Public Service Commission and the FPC. Wisconsin Hydro stockholders will receive 176,300 shares of stock of the Northern States Power Co, of Minnesota, a subsidiary of Northern States Power. Parent company will arrange plans to pay out about $3,200,000 to redeem Wisconsin Hydro's long-term debt and pay off bank loans.

Jefferson City, Mo. — Missouri Public Service Co, 106 W High St, has obtained authority from the State Public Service Commission, to arrange financing in the amount of $6,000,000 through sale of bond issue. Utility, which serves western and north central Missouri, plans to use the proceeds from the sale to pay off short term bank loans and new construction currently in progress. Present construction calls for extensions and improvements in company's generating capacity, power substations, transmission lines and other miscellaneous work.

Dover, N. J. — New Jersey Power & Light Co, 9 W Blackwell St, has announced that construction of a new three-mile transmission line between Mt. Hope and the local substation of the New Jersey Power & Light Co, located at Rockaway, N. J., is well under way. Installation of 45 poles over rugged terrain will be completed in the spring of 1958 and will become part of a loop originating at the new substation at West Wharton and serving Mt. Hope, Picatinny Arsenal and Rockaway, N. J.

Newark, N. J. — Public Service Electric & Gas Co, 80 Park Place, has announced that the company has received approval from the Public Utilities Commission for the sale of bond issue to total more than $60,000,000, proceeds of which will be used to pay off current bank loans and to provide funds for company's current construction program. Major portion of the expenditure has been applied to the completion of the new Linden, N. J., generating plant; advancing the work on the Bergen generating plant at Ridgefield, N. J., and for the acquisition of plant site for the new Mercer generating station in the Trenton area.

Syracuse, N. Y. — Niagara Mohawk Power Corp, 300 Erie Blvd West, has plans for a major construction and rebuilding program over the next three years ending in 1959 at a reported investment of $300,000,000. Company has arranged financing in the amount of $50,000,000 through bond issue to take care of rebuilding program and will be back in the money market again in 1958. Company has already reactivated 88,000 kw of the 370,000 kw of low cost power knocked out by a rock slide in June 1956.

Portland, Ore. — Pacific Power & Light Co, Public Service Bldg, has filed plans with the FPC for permission to arrange financing of a bond issue totalling more than $20,000,000. Funds from the sale will be used in part to finance the company's current construction program which will add 350,000 kw of new generating capacity to the company's system by the end of 1958. Plans call for extensions and improvements in plants and systems, power substations and transmission lines.

Allentown, Penna. — Pennsylvania Power & Light Co, Ninth & Hamilton Sts, has awarded a contract to the Westinghouse Electric Corp, Pittsburgh, Penna., for installation of a 300,000-kw turbine, first of a projected six units planned for the company's Brunner Island Station, located on the west bank of the Susquehanna River, some 15 miles below Harrisburg, Penna. Cost of the unit reported to be about $12,000,000.

Richmond, Va. — Virginia Electric & Power Co, Seventh & Franklin Sts, is arranging sale of bond issue in the amount of approximately $20,000,000, proceeds of which will be used for construction on which the company plans to spend more than $70,000,000 this year. Provisions are being made for the extension and improvement of power generating facilities, transmission lines, power substations and other operating facilities.

4 Outstanding features in this Mead-Morrison Coal-Unloading Tower at "Con Edison"

This Mead-Morrison Coal Unloading Tower has been installed at the Astoria Power-Generating Station of New York City's Consolidated Edison Company.

•

Write for complete information on the many distinct advantages of Mead-Morrison Coal Towers and Bridges.

1

FAST UNLOADING—handles 850 tons of coal per hour with a 10-ton light-weight grab operating on a 43-second cycle.

2

DUST CONTROL—space above the 150-ton receiving hopper is enclosed on top, sides and rear to contain the dust, and a liquid spray system is provided to suppress it.

3

VARIABLE VOLTAGE CONTROL—pioneered by Mead-Morrison over 30 years ago for precise, flexible electrical regulation and economy.

4

ELEVATOR-EQUIPPED—the only travelling unloading coal tower with an elevator for operating and maintenance personnel and tools.

Additional features of this Mead-Morrison installation include a rigid hinged boom which can be raised to clear the dock line, braced frame riveted construction, and two-lever "dead-man" operator's control.

Mead-Morrison

Division

McKIERNAN-TERRY CORPORATION

Harrison, New Jersey

MX810

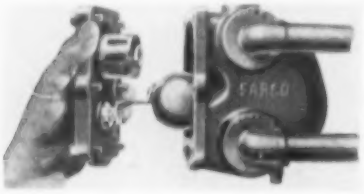
For more data circle 527 on Post Card

EQUIPMENT NEWS

Described on these pages are new and improved products. Use Reader Service Cards on pages 105-106 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

1—STEAM TRAP features single-unit, removable element

Increased accessibility of the Type FT Float-Thermostatic Steam Trap facilitates inspection, maintenance and installation. The entire operating element is one unit, which can be removed without disturbing inlet and outlet connection



to the semi-steel trap body, suitable for 125 psi steam pressure. Operating elements consist of stainless steel valve mechanism, copper float, and bronze thermostatic air vent. Valve is designed to provide condensate seal and prevent loss of steam to discharge condensate at steam temperature continuously and without shock. Separate air vent, requiring no adjustment when pressure changes, serves to remove air and incondensable gases, allowing no steam to escape. The trap is suggested for unit heaters, blast coils, heat exchangers, process applications requiring accurate temperature control. Sarco Co., Inc.

2—ULTRASONIC UNIT locates areas of wear, corrosion

Battery-operated and portable, this ultrasonic thickness measuring unit, the Sonizon SO-200, is designed to locate areas of corrosion or wear on storage tanks, pipes, other structures accessible from one side only. The Sonizon SO-200 is announced as fast and simple to operate. In effect, it gives direct readings of thickness. You select the proper crystal range, place the probe on the test area, and rotate the circular readout dial until the harmonic lines match a pattern of flashing lights. Then you read thickness directly from the dial.

The unit is carried by means of shoulder straps, and dial faces upward for reading convenience. The battery case is also carried by shoulder straps. According to manufacturer, the SO-200 requires no warm-up time; it measures with an accuracy of ± 3 per cent on thicknesses between 0.027 and 4 in.,

and works on practically all materials which will transmit ultrasonic sound — this includes most metals, glass, hard insulators. Magnaflux Corp.

3—TEMPERATURE MONITOR is scanning, indicating device

For use in power plants, textile mills, chemical processing plants, oil refineries, this temperature monitor is a scanning and indicating device designed to automatically check temperatures of up to 40 thermocouples in the range of 100 to 400 F every 10 sec. The scanning circuit scans thermocouple temperatures and triggers an alarm system (visual and aural) that indicates the locations of the thermocouples which have temperatures in excess of a pre-set value. Indicator circuit monitors any one of the 40 thermocouples by means of a manual selector switch. At any time, temperature of any thermocouple can be read from the meter located on front panel. A test push button, also on front panel, can be used to check continuity of the thermocouples and an additional fail-safe relay circuit is provided to assure proper functioning of the alarm system. Pickard & Burns, Inc.

4—CENTRIFUGAL FANS feature airfoil blading design

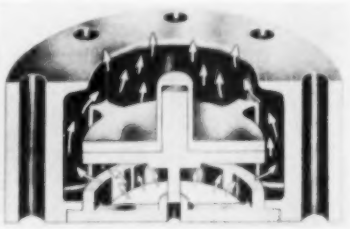
The Series 8000 airfoil centrifugal fans are announced for a broad range of applications, including building ventilation, general air supply and exhaust, conventional and high-pressure air conditioning, industrial processing, tunnel and combustion air supply. According to company, most fan noise is caused by turbulent flow of air set up by conventional flat blades. Airfoil blading is said to create streamlined air flow pattern and make possible perceptibly quieter operation. Power requirements are also claimed lower with the airfoil blade design. The fans are available in standard sizes and will handle up to 700,000 cfm at pressures to 16¾ in. For economical part-load operation, the fans have adjustable inlet vane control which allows control of inlet volume or pressure. Westinghouse Electric Corp.

5—DUST COLLECTOR is wet, scrubber-type unit

The Type IC Hydro-Filter is primarily designed for use where more than one dust collector will be used, or a common settling tank or sludge basin is employed. It is cited as offering several advantages, among them the use of a common settling tank or basin and of a single sludge conveyor for several collectors, with resulting sludge collection operations and equipment centralized for more economical pick-up and disposal. Longer settling time is derived with larger settling area to provide improved collection performance, it is noted, and lower fresh water consumption is realized. The Type IC Hydro-Filter can be elevated above floor level. Like other models in company's Hydro-Filter line, this collector operates under an air-scrubbing principle in which glass spheres are used in the separation action and no moving parts are within collection area. National Dust Collector Corp.

6—CHECK VALVE for gas, air reciprocating compressors

The Williams-Hager Silent Gas-Air Check Valve is vacuum-controlled for gas and air reciprocating compressors not equipped with automatic unloaders. For use in systems including reciprocating compressor with on-and-off operation, the check valve controls surge and "hammer" occurring when compressor is in operation. When the compressor cuts in, the valve disk to which the piston is attached rises. As it does, air is expelled from the cylinder which is part of the valve body. A partial



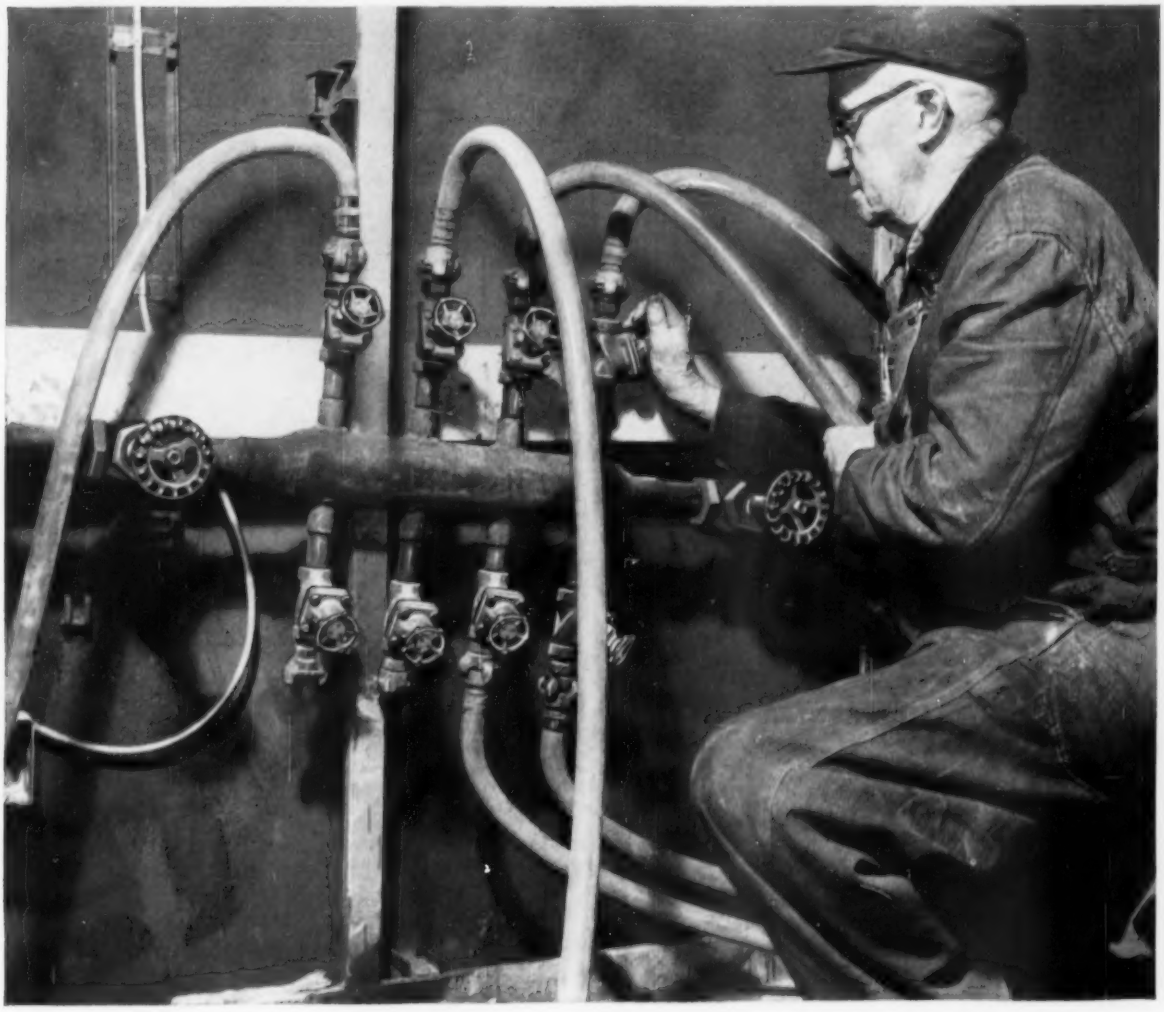
vacuum or suction is built up in the cylinder, holding valve disk in open position while compressor is operating.

When compressor shuts down, weight of the disk forces its return to the closed position. There is only one opening and one closure while the compressor is in operation. Valve operates silently, company says, except when discharge valves of the compressor are leaking badly. In this case it acts as an alarm and pulsates with each stroke of the compressor. Valve comes in sizes from 1½ to 10 in. for pressures from 125 to 2500 lb. It is designed for installation in vertical position only, company points out. Williams Gauge Co., Inc.

7—SUBMERSIBLE PUMP handles both water and muck

This electrical submersible drainer pump is reported to function effectively on heavy-duty water-pumping operations where dirt, grit or other solids are contained in the water to handle water containing up to 20 per cent solids. It is suggested for filter screen sump service, dewatering of mines and quarries, supplying river water intake and similar applications. The pump operates partly

Crane helps another valve user stop high replacement costs



How they solved valve failure on air service

This case history from Willamette Iron & Steel Co., Portland, Ore., shows how you can cut compressed air handling costs in your own plant.

These Crane packless diaphragm valves are handling 100 psi. air on manifolds to distribution lines used aboard ship during construction. Before installing the Crane ¾-inch No. 1610 valves, the yard was troubled by constantly rising maintenance costs. With the other make valves, diaphragms were rupturing after a short time, requiring continual replacement. Loss of air and air power for equipment was costly.

Crane packless diaphragm valves were installed because their neoprene diaphragm functions only as a bonnet seal, and is not subjected to crushing and wear when used as a seating member. The maintenance problem was effectively solved, as it is for so many users throughout industry, by installing the right Crane valve. Contact your Crane Representative today—ask him for complete information on any application.

ASK FOR Crane Folder AD-1942 on packless diaphragm valves. Contact your Crane Representative for a copy, or write to Crane Co., at address below.

CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

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or completely submerged. A built-in thermostatic cut-off protects motor against damage from overheating obstructions or overloading; an automatic reset restarts pump when obstructions are removed or overloading relieved.

The submersible motor operates in a factory-sealed oil bath, and is cooled by discharge water. This heavy-duty squirrel cage, three-phase 60-cycle motor is rated 7½ hp. The pump has a capacity of 460 gpm at 15-ft head. With a 70-ft head, the pump handles 145 gpm. It can be used for portable service or permanent installations. Sumo Pumps, Inc.

8—FLEXIBLE COUPLING has rubber toothed sleeve

There are only three basic parts to the Sure-Flex Coupling: two hub-flanges and a two-piece rubber sleeve. Internal and external teeth of the flexible sleeve mate with the flange hub teeth and lock under torque load without clamps or screws. The elastic rubber sleeve with two planes of engagement absorbs both

angular and parallel misalignment, it is pointed out, and also, since there are no rubbing or wearing surfaces there is no need for lubrication. Shock vibrations are absorbed and prevented from being transmitted by the coupling sleeve, says manufacturer, and high torsional flexibility (about 15 deg at peak torque) provides smooth power transmission.

Sure-Flex Couplings are designed to tolerate angular misalignment up to 1 deg, parallel misalignment from 1/32 to 1/16 in., depending on shaft size, and free end-float up to 1/16 in., depending on size. According to company angular or parallel misalignment does not generate unbalance or pulsations since flexing takes place within the rubber sleeve member, and operation is noiseless. Final assembly of the coupling can be made without tools. The couplings come in six sizes for motors from 3 to 80 hp. T. B. Wood's Sons Co.

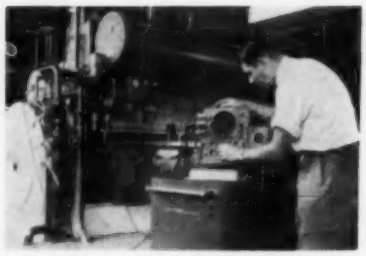
9—MOTOR STARTERS are completely front accessible

Type H Motor Starters, rated 2300 to 4160 v, are designed for full or reduced voltage starting, reversing or non-reversing, dynamic braking or multi-speed control of squirrel-cage, synchronous or wound rotor motors. Completely front accessible, starter is compact, with basic unit measuring 34 in. wide by 32 in. deep. It is available with either air break or oil immersed contactors up to 1500 hp at 2300 v or 3000 hp at 4600 v. Short circuit protection of 150,000 kva at 2300 v and 250,000 kva at 4160 or 4600 v is by current limiting fuses. Allis-Chalmers Mfg. Co.

10—ANALYZER monitors engine ignition, vibration, pressure

Inner mechanical functioning of complex industrial engines can be checked without shutdowns, with this hand-portable, multipurpose analyzer, it is announced. According to manufacturer, the equipment displays, pictorially, information formerly obtained from three electronic instruments; and it enables operators to monitor reciprocating engines — whether spark ignited or diesel — to keep them at continuous peak efficiency. It also serves to detect and pinpoint malfunctions as they develop within engines. It provides data on ignitions, vibration and pressure.

The analyzer, employing a specialized oscilloscope, probes inner recesses of engines and presents information on a 5-in. cathode ray screen. Electronic data is transmitted from connections to the engine, through wires to the control unit, where it is transformed into pictorial information. It is attached and operated while an engine is running. Manufacturer says it will detect and analyze many malfunctions and maladjustments, and will detect — within 1



deg of crankshaft position — any ignition mistiming.

In operation, a sweep is driven across the cathode ray tube in time with the engine. The resulting trace line shown on the screen is responsive in the vertical direction to signals from ignition, cylinder vibration and cylinder pressure. Four connections to the engine are required: one each to the flywheel, ignition primary circuit, and two to a power cylinder. Timing the analyzer to the engine is accomplished by a fifth pick-up near a mark on the flywheel. Connections may be made without stopping engine. Sperry Gyroscope Co.

11—FHP MOTOR designed for abnormal operating conditions

Form G Motors are severe-duty, single phase 60 and three phase 60/50 cycle units especially designed for applications where operating conditions are abnormal. Among features cited are: totally enclosed non-ventilated construction, base welded to stator shell, stainless steel shaft, cast-iron shields, and corrosion-resistant finish on both internal and external surfaces. Stator windings on all models are protected by special insulation and double varnish impregnation. Splashproof capacitor construction is featured on all models with capacitors. Motor comes in ratings of 1/6 through 3/4 and in speeds of 3450, 1725 and 1140 rpm. General Electric Co.

12—HEAT-LOAD CALCULATOR shows heat loss in watts

This electrical heat load calculator is designed to give accurate readings of heat loss in watts, enabling quick selection of proper heating unit required for a given space. It covers U factors from

0.06 to 1.13. On its reverse side is a condensed list of more commonly used factors. It is based on 70 deg temperature differences; slides for other temperature differences are available. It is 9 in. long, made of clear plastic, and sells for around $3.00. Paul S. Morton Engineering Service.

13—COMPACT INDICATORS for control panel installations

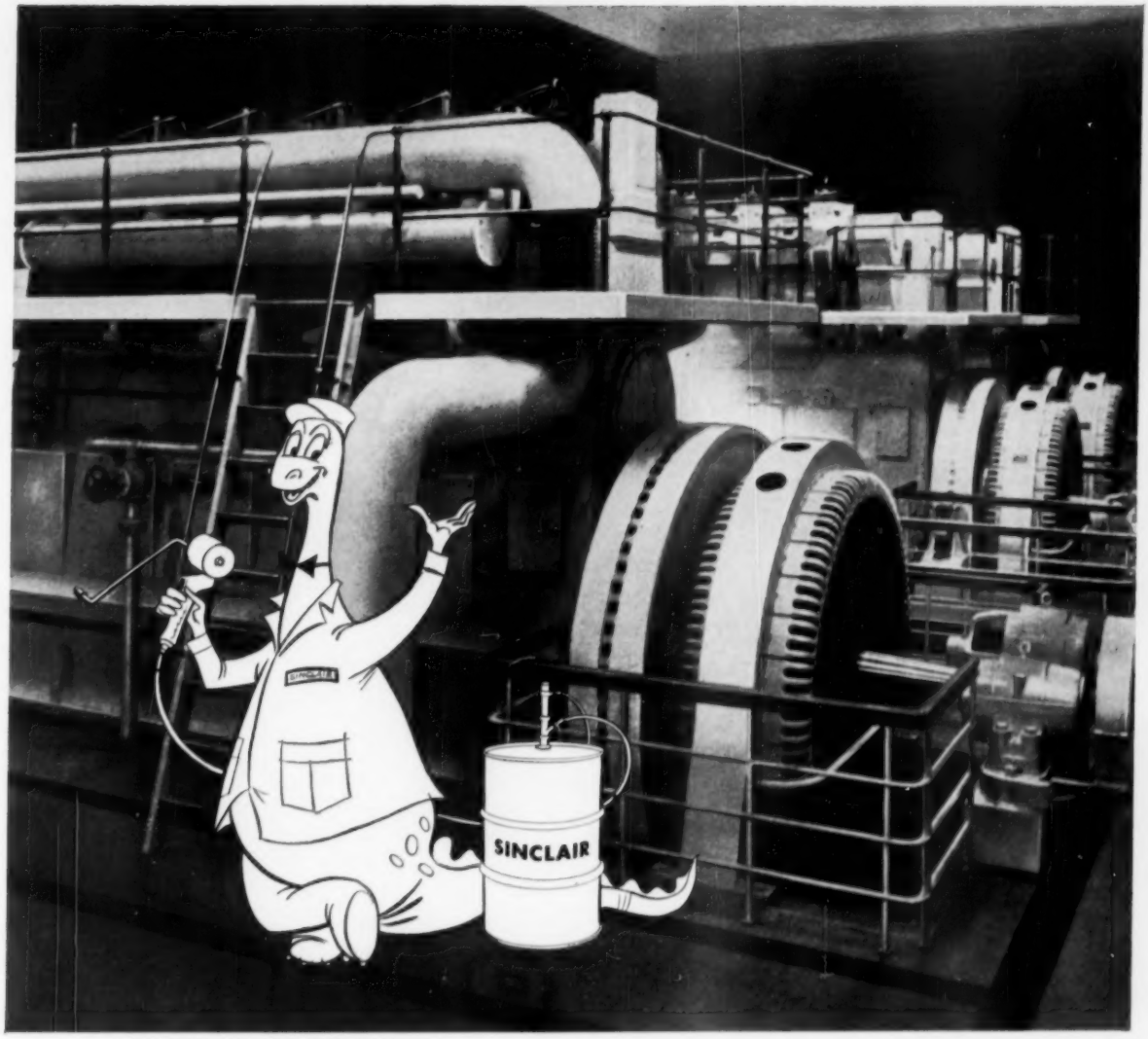
Space saving instruments in this company's SS Series can measure draft, pressure, differential gas pressure and temperature, or function as receivers with pneumatic transmitters for indicating flow, liquid level, density, high pressures and other process variables. As many as eight indicators can be grouped in a mounting case, measuring less than 14 in. across. The illuminated 5-in. scales are of white translucent plastic, reported easy to read even at a distance.

Adjustments can be made without removing indicator element from case, it is noted; removal of rear panel allows access to vernier adjustments of the pointer alignment, zero setting and calibration. Three types of indicators — diaphragm, bellows or helix type — can be supplied, depending on requirements. Each indicator is an integral unit assembled independently of case, and is interchangeable with other units in the line. Bulletin MSP-121 gives data. Hagan Chemicals & Controls, Inc.

14—PLASTIC PIPE designed for hot water service

Now going into production is a plastic hot water pipe, called Kralastic HTHT, said to combine toughness of synthetic rubber with mechanical strength of plastic. Chemically, this plastic is a combination of acrylonitrile, butadiene and styrene. Tests are reported to show that it has considerable strength at 220 F, and is about twice as strong as most pipe plastics at 160 F. According to announcement, it is light weight, corrosion resistant, even resists swelling through water or chemical absorption. It can be extruded or injection molded, says manufacturer, and pipe or parts made from it are stiff and able to withstand heavy impact. Its standard color is black, but it can be pigmented in a limited range of colors. It is reportedly priced about the same as pipe plastics now in use.

Several advantages are anticipated for plastic hot water pipe: water kept hot longer in it, because plastic is a



Maintenance tips from Dino, the Sinclair Dinosaur

NOW- less oil consumption

Sinclair RUBILENE® Oil has a great reputation in industrial Diesel applications – and for several good reasons. Engineers have found that Sinclair RUBILENE can cut oil consumption, reduce service time to a minimum. It prevents the formation of harmful carbon, sludge and varnish. It stands up under the highest operating temperatures, provides better lubrication protection to cylinders, pistons, rings and other vital moving parts.

Switch to Sinclair RUBILENE and lower your costs. Whatever the make or age of your Diesel, whatever your lubrication problem, there's a RUBILENE or RUBILENE HD Oil that should meet your requirements. Call your Sinclair Representative for further information or write for free literature to Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N. Y. There's no obligation.

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RUBILENE OILS

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better insulator than metal; no rust or corrosion; lower initial cost; and lower installation cost because plastic pipe can be joined with a sleeve-type fittings and solvent cement. A possible use for plastic hot water pipe is in radiant heating pipes, it is stated, and the major initial use is expected to be in applications where standard plastic pipe materials are now being used. Its greater strength will be an added safety factor, and its high heat resistance will permit use where many plastics are unsuccessful or where operating temperatures were formerly considered too high for plastics. Naugatuck Chemical Div., United States Rubber Co.

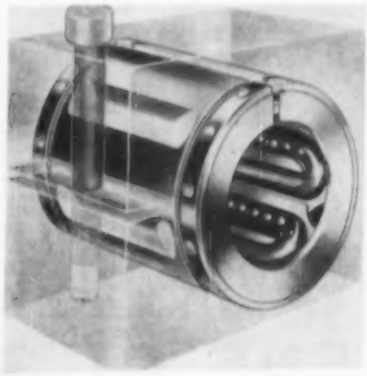
15—MAGNETIC GAGE for observation of liquid levels

This magnetic gage for observation of liquid levels is especially designed for use where most gages with glass, gaskets and threads cannot be tolerated, due to dangerous inflammable or explosive conditions. Safety against slightest escape of gases is assured, company says, by design which incorporates gaging mechanism in a stainless steel chamber, mounts the scale outside the chamber, and accurately indicates level by magnetically actuating the scale through the chamber wall.

The scale consists of a series of edge-magnetized wafers which are attracted to each other to give a continuous scale. One side of wafers is bright red, the other side silver. Changes in liquid level operate a float which in turn magnetically turns over the wafers; thus liquid level is accurately shown on the scale in a continuous red band contrasted with silver above. Gages are built to order to fit specific installation. At present they are offered for pressures to 2500 lb, 600 F, for use as liquid level gages or for indication of interface. Jerguson Gage & Valve Co.

16—LINEAR BALL BEARING with adjustable diameter

Designed for linear motion, these adjustable diameter ball bushings are split longitudinally and designed to provide line-to-line or slight preload fits when mounted in an adjustable diameter housing. Free-running no-play linear motion is said to be a simple matter, as the bearings enable the tolerance on both shaft diameter and bearing bore to be adjusted out. In addition, the principle provides for compensation for wear that might eventually develop in severe applications. In some instances the bearings are used in a housing that is merely split and provided with an adjusting screw. Bearings are available in standard sizes for shaft diameters of 1 to 4 in. Thomson Industries, Inc.



17—WIRING RACEWAY is completely self-extinguishing

Improved Panel Chanel is made of a tough reinforced phenolic claimed not to support combustion. If subjected to direct flame, it is immediately self-extinguishing without after-glow when

the flame is removed, according to company. The new material used in this raceway is said to offer an improvement in fire-retardant properties without sacrifice of other important qualities of the phenolic-base composition. It is lightweight, durable, and does not warp or sag even under high temperatures normally encountered in panelboards. Bulletin S-302 gives gurther information on this. Stahlin Brothers, Inc.

18—ACOUSTICAL BOOTH brings phone service to noisiest areas

Model U-10 Acousti-Booth is said to transform any location into a comfortable, semi-enclosed quiet-zone where full concentration may be placed on the phone call. Model is furnished ready to be mounted on wall or desk, and may be changed from wall to desk or back again. Standard colors are light ivory inside and silvery gray outside, and steel construction is featured for durability. Size is approximately 30 in. high, 30 in. wide and 28 in. deep. General Sound Control, Inc.

19—CHEMICAL FORMULATIONS for boiler, equipment cleaning

Three chemicals are introduced for simplifying cleaning of boilers and industrial equipment. Nalco 85, a boiler cleaning aid and supplementary treatment, is reported to remove a high percentage of deposit. Alkaline in nature, it may be applied to an operating boiler, manufacturer states. Nalco 85 is also said to cut cleaning time; clean headers and other areas inaccessible to manual cleaning; disperse calcium carbonate deposits; and require no neutralizing after cleaning.

For industrial process and heat exchange equipment, Nalclean 66 and 68 are described as powerful cleaning agents. They are blends of both organic and inorganic acids, and claimed highly effective in removing a variety of scale and deposits. In addition, says manufacturer, they contain corrosion inhibitors which protect metals commonly found in industrial equipment, and they minimize hazards to personnel. They are made in a dry, pulverized form and incorporate an indicator dye to show when solution strengths are depleted. National Aluminate Corp.

20—PROPORTIONER mixes, pumps dust control solution

The Type J is a chemical proportioner designed to automatically proportion surface active wetting compound with water and pump the mixed solution at variable rates of flow. This liquid proportioner is used with latest of manufacturer's liquid dust control systems. Pump, motor and proportioner are incorporated inside one housing to save space and protect equipment. Capacity range has been extended. One model delivers the mixed wetting solution at 0 to 50 gpm, another at 40 to 100 gpm. Larger sizes can be made for capacities to 500 gpm. Standard inlet pipe sizes are 1, $1\frac{1}{4}$ and $1\frac{1}{2}$ in. A dual tank system employed offers nearly three times the usable storage capacity formerly available for the mixed solution. The Johnson-March Corp.

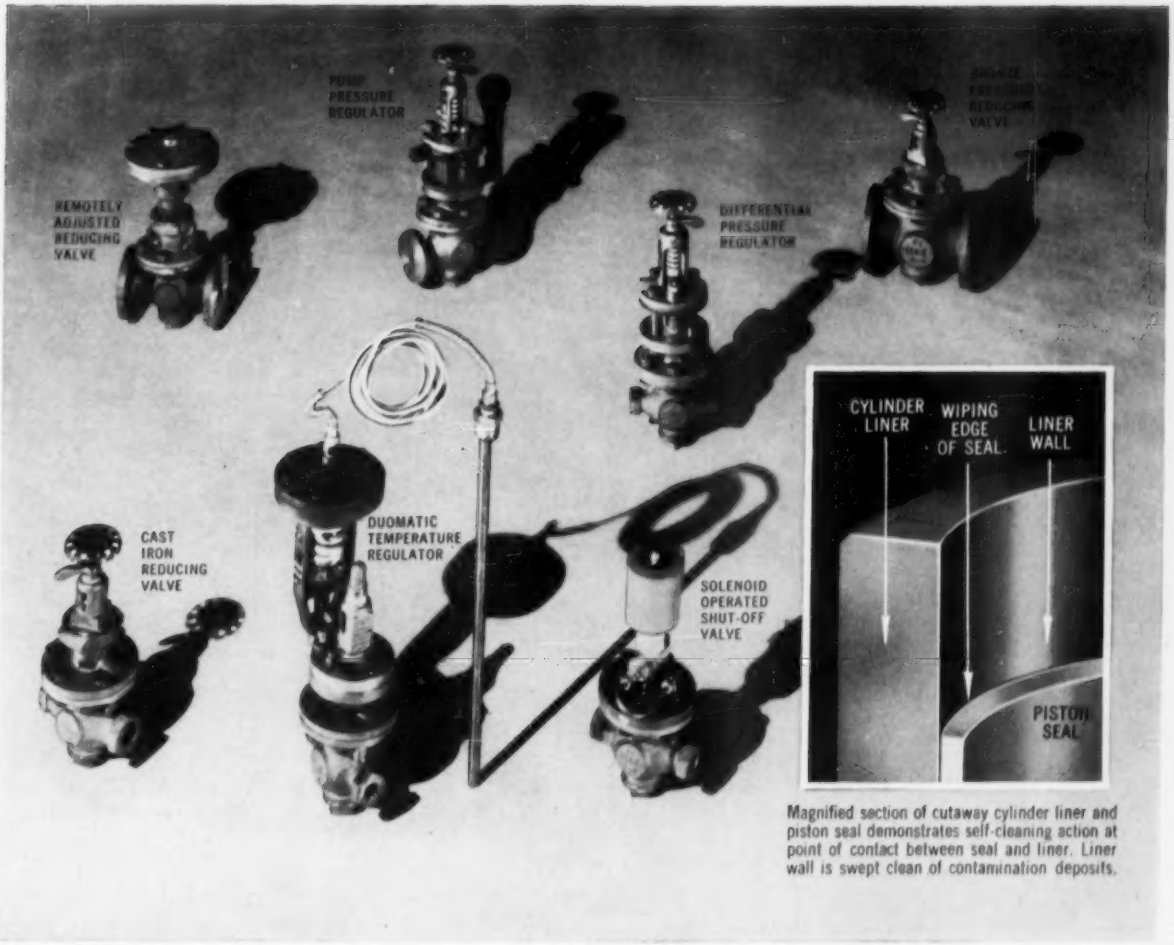
21—WIRE CONNECTORS are pre-insulated spring type

Recent additions to company's Scotchlok brand of electrical connectors are the Type Y (yellow) a fixture connector, and the Type B (blue) a heavy duty connector. With the existing Type R (red) connector, the three sizes accommodate AWG wire sizes from No. 6

through 18 in over 400 combinations, it is pointed out. The connectors consist of a cone-shaped coil spring within a steel sheet to prevent crushing in junction boxes. The vinyl insulating jacket, molded over the unit, features a triangular cross-section for a better finger grip during application. It also includes a skirt at the bottom to protect the wires and prevent flashover. In use, the connectors are simply twisted on the ends of the wires to be spliced — the cone-shaped spring construction providing threads and gripping the wires firmly. Minnesota Mining and Mfg. Co.

22—ORIFICE RING FAN for V-belt or flat belt pulley operations

The Type PD is a belt driven orifice ring fan designed for operations using diesel, gasoline, steam, or electric motors. Unit incorporates an oversized shaft to accommodate maximum horsepower used and is suitable for V-belt or flat belt pulley operations. By changing pulley diameters, unit may be adapted to



Magnified section of cutaway cylinder liner and piston seal demonstrates self-cleaning action at point of contact between seal and liner. Liner wall is swept clean of contamination deposits.

. . . another LESLIE Quality First!

REGULATORS WITH SELF-CLEANING PISTONS

. . . at no extra cost

Now it can be told! After 3 years of exhaustive field tests and over 5,000 installations, Leslie announces the standardization of exclusive self-cleaning, pressure sealing pistons for reducing valves, temperature and pressure regulators in ½ to 6" sizes — another Leslie FIRST!

Continuous Wiping Action

The continuous "wiper" action of the new piston's seal keeps the cylinder liner clean, improves reliability, reduces maintenance.

The molded self-lubricating piston seal has already proved itself in high temperature service up to 500°F.

Reduces Wear and Sticking

The resilient cushion between the piston and cylinder liner reduces wear and eliminates "freezing" or sticking of these parts. The self-lubrication and pressure-sealing of the new piston insures smooth, dependable operation even in the toughest applications and where long standby periods are a problem with ordinary regulators.

Fully Interchangeable in Field

You can have this desirable new Leslie FIRST in *any* piston-operated Leslie regulator now in steam service for all temperatures up to 500°F. A quick conversion kit is available and your present Leslie Regulator can have the new seal added in a matter of minutes.

More Information

More data is available — send for these aids without obligation.

Data Sheet RV-51C — Instructions for converting your present Leslie Regulator to self-cleaning piston type
Bulletin 5302-B — Reducing Valves and Pressure Regulators
Bulletin 5307-A — Temperature Regulators

Or ask to see a demonstration model of the new pressure seal piston.

LESLIE **REGULATORS and CONTROLLERS**

LESLIE CO., 301 Grant Avenue, Lyndhurst, New Jersey

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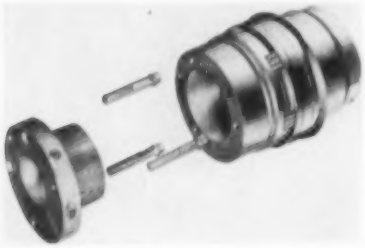
cooling of special equipment, or exhausting of various acids and fumes. Featuring an aerodynamic blade design, a high pressure air pattern without dead spots is produced. Announced as responsible for the fan's high efficiency yet maintaining low noise levels, are the airfoil blades. These one piece, hollow blades, large at the hub, decrease to small values at the tips, causing even distribution of air velocity over entire blade surface. Produced in 10 sizes, ranging from 12 to 72 in., wheels are available with either 2, 4, 6 or 8 bladed steel or aluminum, depending upon pressure requirements and individual specifications. Chicago Blower Corp.

23—FLEXIBLE COUPLINGS adapted to taper bushings

This line of flexible couplings, taper-bored for use with QD taper bushings, comes in six sizes ranging from 22 to 150 hp at 1750 rpm. Stock bushing bore sizes begin at ½ and progress to 3½ in. by sixteenths of an inch. The couplings



are designed to accommodate standard QD bushings. Advantages reported include: reduction of normal stock requirements of coupling bodies; immediate availability of a wide range of shaft sizes from this reduced stock by means of a complimentary stock of QD bushings; and a coupling-bushing combination that affords easy fastening to the shaft with the firmness of a shrunk-on fit. Lovejoy Flexible Coupling Co.

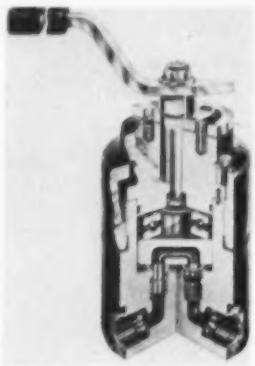
24—SHAFT-MOUNTED DRIVE offers larger capacities

The all steel 315J Shaft-Mounted Drive is available in single reduction ratio of 5:1 and in two double reduction ratios of 14:1 and 25:1. Unit ratings range from 2 hp at 5 rpm to 50 hp at 359 rpm; maximum torque rating at low speed shaft is 31,000 lb-in. A longer center distance between shafts permits use of larger sheaves on installations where unit is mounted with input shaft toward driven machine or on through-shaft applications. Inspection covers on the three-wall one-piece steel housing provide easy inspection of bearings and helical gears. An automotive type dip stick is provided for a quick check of oil level. Bulletin 7100 gives details on this drive. The Falk Corp.

Reader Service Cards on pages 105–106 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

25—FOUR-WAY VALVE for high pressure liquids, gases

This 10,000-psi four-way valve series comes in pipe sizes from ¼ to 1 in., but may be had with tube, AND 10050 or special high pressure connection. Manufacturer says it will withstand surges up to 15,000 psi without damage to its sealing qualities and is designed



for a burst pressure of 30,000 psi. In the Shear-Seal principle of extreme pressure control incorporated, lapped optically flat metal-to-metal sealing surface of the sealing rings and mating rotor face always maintain intimate contact. Flow travels only through the center of the Shear-Seal, not across sealing surfaces. According to manufacturer, sealing qualities actually improve, as the self-aligning Shear-Seals lap themselves to a more perfect fit with each valve operation. This is said to mean no port-to-port leakage in detented positions over a long period without frequent overhauling. There is claimed to be no chance for external leakage because pressure is confined to flow passages. Barksdale Valves.

26—PIPE SQUEEZER for simplified gas line repairs

The Flow-Stop Pipe Squeezer consists of a hydraulically operated ram and a pair of jaws that clamp around the pipe. Pressure of the ram against the jaws compresses the pipe until the flow is shut off. The Flow-Stop Pipe Squeezer

is suggested for relocating service lines and mains, and repairing leaky and ruptured lines and mains. In these operations, the squeezer is placed on the upstream side of the line, with pressure applied until flow is stopped. The line is then repaired, and the squeezer used as an opener by placing it over the pipe at a right angle to the edge of the pinch. On ruptured lines' damaged portion is cut out and new pipe welded in before reopening.

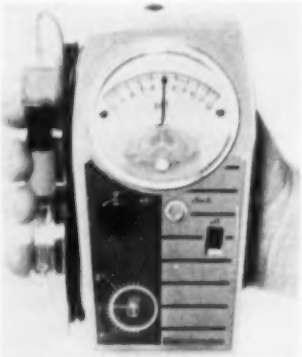
Other uses of the tool are to speed trenching operations and to shut off service to buildings threatened by fire when valves are inaccessible, to close service lines on buildings to be demolished, and to use as a line-up clamp in welding pipe. There are two models. Model 5024, for use on cold nominal pipe up to 2½ in., and copper pipe to 3 in. OD, operates at pressures to 7500 psi. Model 5045 is for use on heated nominal steel pipe up to 2 in., copper pipe to 2½ in. OD. This unit operates at pressures up to 5000 psi. Regent Jack Mfg. Co., Inc.

27—FORCED DRAFT BURNER for all types of fuel gas

This industrial forced draft, flange mounted gas burner (RGF-F Series) is reported lower in cost than conventional forced draft burners and easier to install. It is for use with Scotch marine or other types of high or low pressure boilers and can be attached by bolting the burner assembly to boiler front. Burner is designed to fire all types of fuel gas with high combustion efficiency and a wide turn down ratio. All essential elements of burner mechanism, including controls and forced draft air supply, are factory assembled. An enclosed electronic control panel is on the unit. Iron Fireman Mfg. Co.

28—POCKET pH METER gives on-the-spot readings

This pocket-sized, pocket-priced instrument is suggested for testing feedwaters to prevent equipment and pipeline corrosion, and for spot-checking automatic systems that control wash, waste, cooling tower, blowdown and



boiler waters. Manufacturer says that anyone can use this instrument after reading the instructions. A feature claimed for it is the combination glass and reference electrode with 36-in. lead. This electrode may also be used while clamped to the instrument's side — allowing the operator a free hand to make notations. The meter is 6 in. long, 3 in. wide, 2 in. deep, and weighs 2 lb. Measurements in the range of 2 to 12 pH are reported possible with a readability of 0.1 pH; lower pH values can be measured by a simple adjustment. Power is supplied by six standard type batteries. Scientific Instruments Div., Beckman Instruments, Inc.

more Equipment News page 117

INGENUITY

call KE for plant expansion or new facilities

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Our most treasured ingredient at Kaiser Engineers is ingenuity. It manifests itself constantly in new, more efficient, and tested ways of designing and building our clients' plants.

Veteran KE engineers can take your facilities idea from a gleam in your eye through start-up. Or, they can perform any part of the project. One contract can cover all.

KE ingenuity—applied in fresh, daring ways since the start of contracting in 1914—can benefit your facilities. Investigate KE now!

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Consulting Engineers: Seelye, Stevenson, Value & Knecht. Heating Contractors: Almirall & Co., Inc. and Norman Heating Co., Inc.; Eugene J. Brandt & Co., Inc.

LARGE TRENCH AT IDLEWILD shows one expansion loop in foreground and another in background. Note large pipes for chilled water lines running outside of the walled trench containing the high temperature hot water system. The control tower is in the center of the photograph, and the new International Arrival Building is at the right of the tower. The bags of GILSULATE are slid down boards into the trench.

$90,000,000 Idlewild expansion program uses 1515 tons of GILSULATE to protect 7 miles of pipe

New York International Airport Has One of World's Largest High Temperature Hot Water Systems

By 1960 "Terminal City" will be a completed reality at New York International Airport. This gigantic undertaking comprises 655 acres and will be equipped to handle 140 aircraft at one time. Estimated cost of the project is $90,000,000.

Running from a central heating plant to each of the projected buildings in Terminal City is one of the world's largest non-military high temperature hot water systems ever designed. This system, operating at 380°F on the supply and 240°F on the return lines, includes 38,774 feet of pipe (7.34 miles!), virtually all of which is protected with 1515 tons of Type B GILSULATE. In this gigantic system, expansion loops alone total almost one mile!

Big job or small job, GILSULATE offers the same unique protection for underground hot pipes—and the same opportunity for on-the-job savings. GILSULATE is easy to install; it calls for no trained fitters or applicators, no special installing equipment. So whether *your* piping job is large or small, you'll find that GILSULATE fits right into your specification picture—at a lower cost per installed linear foot than any other underground hot pipe insulation.

For more complete information, see your local GILSULATE distributor, or write any of our offices listed below.

Artist's sketch of Terminal City showing proposed buildings and extent of high temperature hot water system.

FACTS ABOUT GILSULATE

1. **EASY TO USE**—just pour and tamp...pipe heat does the rest.
2. **FORMS 3 ZONES** of protection against heat loss and all hazards commonly encountered by buried hot pipes.
3. **NEEDS NO HOUSING OR MECHANICAL SHEATHS**: no mixing, special handling or equipment.
4. **ONLY NEEDS NORMAL PIPE SPACING**: for multiple pipe or cramped conditions.
5. **THREE TYPES AVAILABLE:**
   Type A for 220°-300°F. temp. range
   Type B for 300°-385°F. temp. range
   Type C for 385°-520°F. temp. range

AMERICAN GILSONITE COMPANY
SALT LAKE CITY 1, UTAH

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GILSULATE®
The Triple-Zone Insulation System for Lifetime Protection of Underground Hot Pipes

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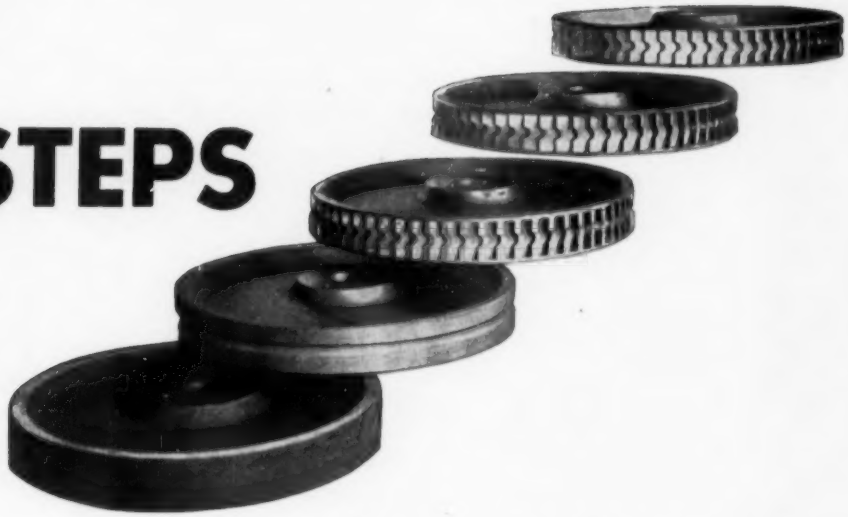
5 STEPS



in making an almost indestructible turbine

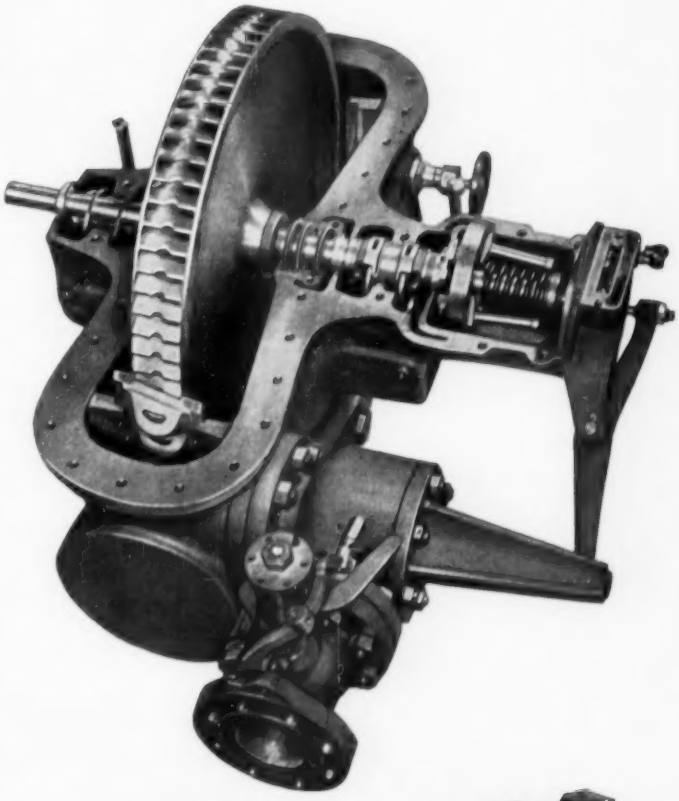
The rotor of a Terry solid-wheel turbine is a single forging of special composition steel. It is first rough turned in two operations, as shown, and then two cuts are taken to mill the semi-circular buckets from the solid metal. The wheel at the top has been finished, ready for mounting on the shaft. *The result is a single-piece wheel with no parts to loosen or wear out.*

Blade wear, which might occur after many years of usage, is not important, because the power-producing action of the steam takes place on the curved surfaces at the backs of the buckets. Thus wear does not materially affect horsepower or efficiency.

The blades can't foul. They have a one-inch clearance, and are further protected by the projecting rims at the sides of the wheel.

The Terry solid-wheel turbine is an extremely reliable piece of equipment. Write for details—today. Ask for a copy of bulletin S-116.

THE
TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.



TERRY

TT-1204

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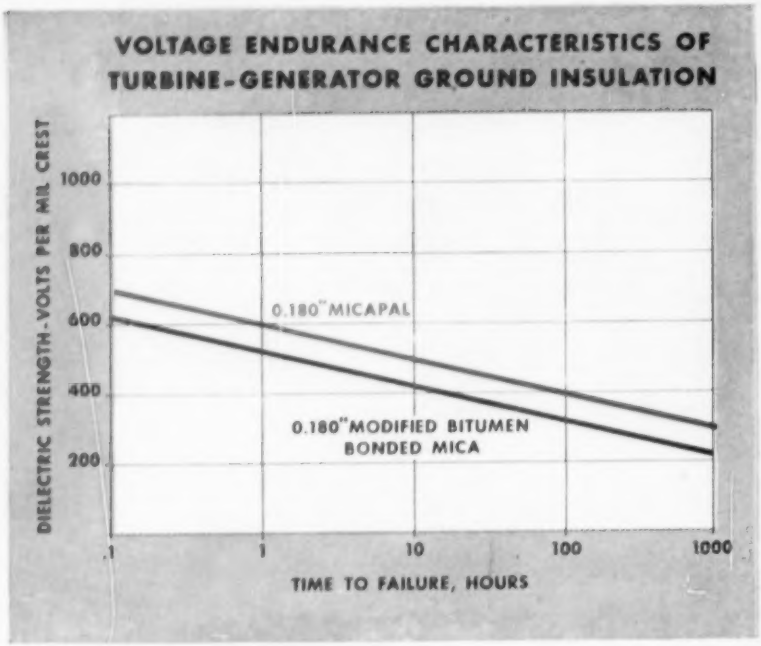
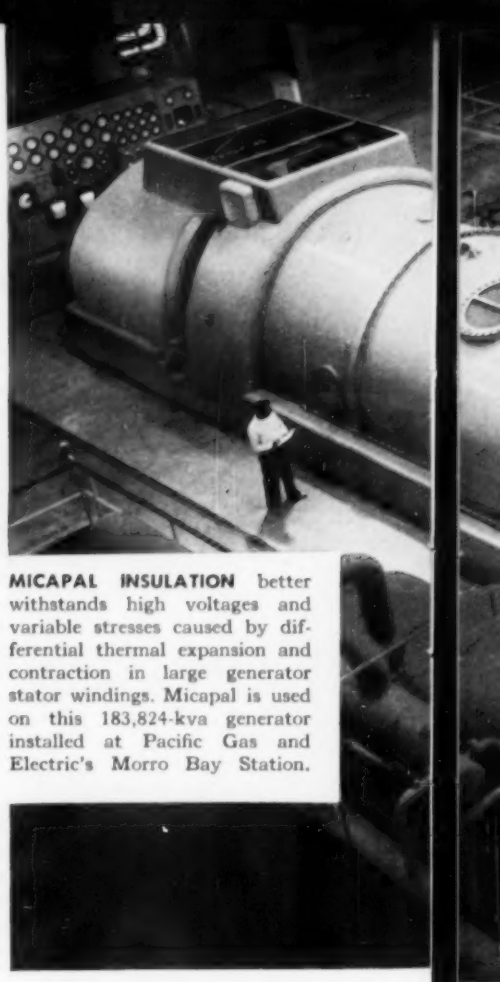
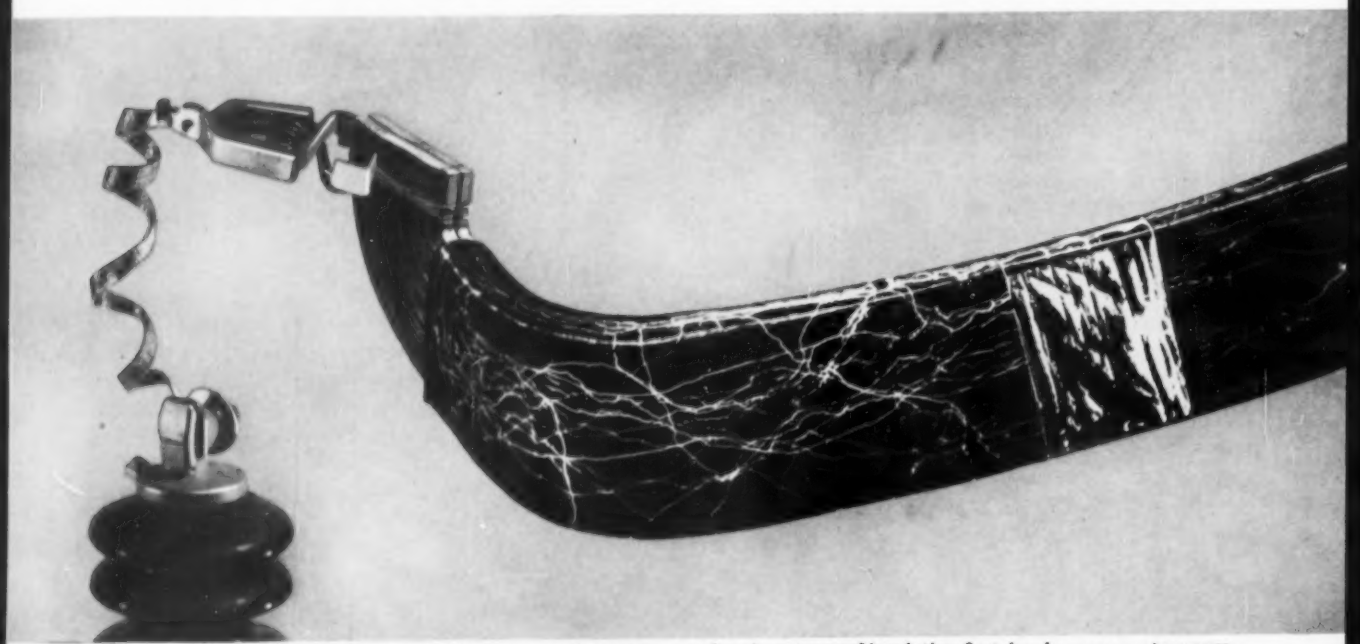


SIGNIFICANT IMPROVEMENT is noted in voltage endurance obtained for any duration of voltage application on Micapal compared to presently accepted generator insulating material. This improved voltage endurance increases long-term turbine-generator availability.

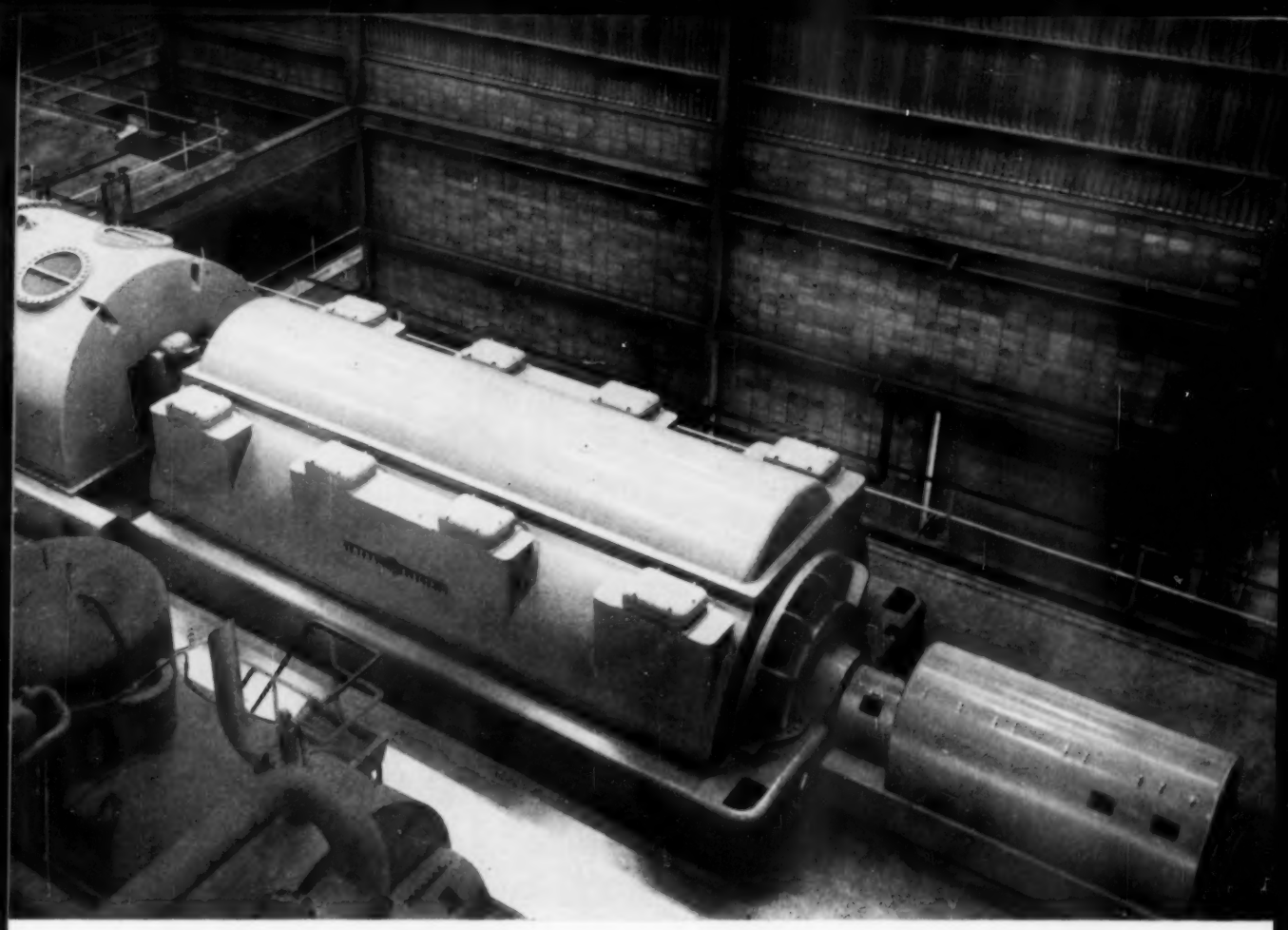


MICAPAL INSULATION better withstands high voltages and variable stresses caused by differential thermal expansion and contraction in large generator stator windings. Micapal is used on this 183,824-kva generator installed at Pacific Gas and Electric's Morro Bay Station.

How General Electric Micapal



INSULATION TESTS such as pictured here are used to compare the dielectric breakdown of different insulations. Forced to carry voltages far above their rating, test bars of various types of insulation first develop corona streamers, then finally fail, enabling engineers to measure the insulation's actual voltage endurance.



insulation extends generator life

IMPROVED INSULATION BETTER WITHSTANDS HIGH VOLTAGES, VARIABLE STRESSES

Now, after extensive research and four years of operating experience, General Electric announces the extended application of Micapal insulation for high-voltage stator windings. A major advance in providing still longer, more reliable operation, this mica-based insulation offers these distinct advantages:

Greater Tensile Strength. Micapal incorporates mica mat and some mica flake bonded with a duplex thermosetting resin. Mica mat is finely divided, reconstituted mica formed into sheets. The thermosetting binder, combined with uniform mica structure, makes Micapal much tougher at operating temperatures than earlier insulations.

Greater Dimensional Stability. Micapal is molded to the precise shape of generator armature bars. Because of thermosetting qualities, the insulation won't flow or lose shape. It possesses great mechanical strength over the full range of operating temperatures.

Improved Thermal Conductivity. Micapal removes heat from electrical conductors more easily. The result is that for a given current and same insulation thickness, the armature bar runs cooler.

Improved Dielectric Breakdown Strength. The voltage endurance characteristics shown on the chart, above, illustrate how Micapal insulation withstands a much higher voltage than other mica insulation for any given period of time. The impulse puncture structure of Micapal has been shown by laboratory tests to be higher by an even greater factor.

Improved Micapal insulation is just another example of General Electric steam turbine-generator progress in meeting tomorrow's power demands. For more information on new generator developments, write Large Steam Turbine-Generator Department, General Electric Company, Schenectady 5, New York.

254-41

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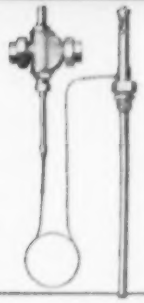
Low-cost Temperature Control — by SARCO

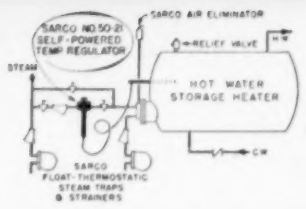
Self-Powered and Electric Indicating



Sarco Temperature Controllers
Self-Powered . . . Fully Modulating

Simple as ABC . . . a thermostat with capillary tubing and a valve. That's all! Operated by liquid expansion. Automatic. Self-powered . . . no electricity or compressed air required. Self-contained . . . no exposed mechanism. Packless valve . . . no stuffing box to leak or stick. Easy to install by any pipefitter.

Furnished with thermostats suitable for any liquid or for air in dryers, ovens, air ducts, etc. Valve sizes . . . ½ to 6". Temperature ranges to 300°F. *Bulletin 620-2.*

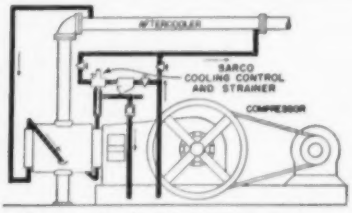


Typical applications: Shell and tube heat exchangers; condensers, oil storage tanks, dryers, etc.

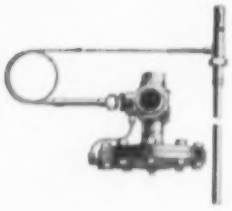
Sarco Cooling Controls
Self-Powered . . . Fully Modulating

Simple, compact, automatic thermostatic valve. Eliminates overcooling and undercooling. Saves water. Overall height of ¼" size is only 17/16". Self-powered . . . requires no electrical or compressed air hook-up. Valve and bulb all in one unit. No exposed mechanism. Single-seated packless valve . . . not affected by silt or scale-forming minerals.

Valve sizes . . . ⅜ to 1½". Temperature ranges between 40° and 210°F. *Bulletin No. 710-B.*



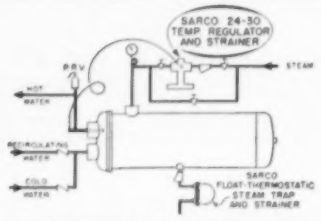
Typical applications: compressors, small engines, water-cooled bearings, condensers, dry cleaning stills, etc.



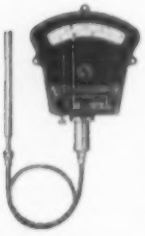
Sarco Temperature Controllers
Self-Powered . . . Single-Seated, Tight-Closing

A simple, self-powered automatic temperature controller with diaphragm-operated, pilot-controlled valve. Designed for intermittent service or service involving long periods with practically no call for steam. Self-powered by liquid expansion . . . no electricity or compressed air needed. Packless.

Valve sizes . . . ½ to 3". Temperature ranges to 300°F. *Bulletin No. 625-B.*



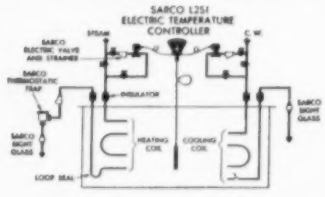
Typical applications: instantaneous heaters, fuel oil pre-heaters, high pressure applications on hot water storage tanks.



Sarco Electric Temperature Controllers
Indicating Type

Simple, inexpensive, electric-indicating automatic temperature controller. Sensitive enough to perform many of the functions of much more elaborate recorder-controllers, at a fraction of their cost. Responds to changes of ± ½°F. Adjustable. Large, easy-to-read scale shows both actual and set temperatures.

Temperature ranges between minus 90° and plus 650°F. Offers many sequence combinations such as step-heating. *Bulletin 1025-B.*



Typical applications: plating tanks, processing vats, kettles, chemical tanks, etc.

Sarcostat Hydraulic Motor Valves
Electrically Operated

For remote control by hand or thermostat. Open and shut operation. Can be equipped with semi-modulating mechanism. Powerful hydraulic action operates valves up to 5" single-seated, or 8" double-seated, at pressures up to 175 psi. Ruggedly constructed . . . to withstand severe use without constant supervision and with minimum maintenance. Operates in any position.

For direct connection to 110 volts A. C., 60 cycle current. Valve sizes . . . ½ to 5" single-seated; ½ to 6" double-seated. *Bulletin 1080-A.*

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From one "Complete Line" source . . . SARCO-SARCOTHERM . . . for temperature controllers, steam traps and other heating specialties.

2230-B

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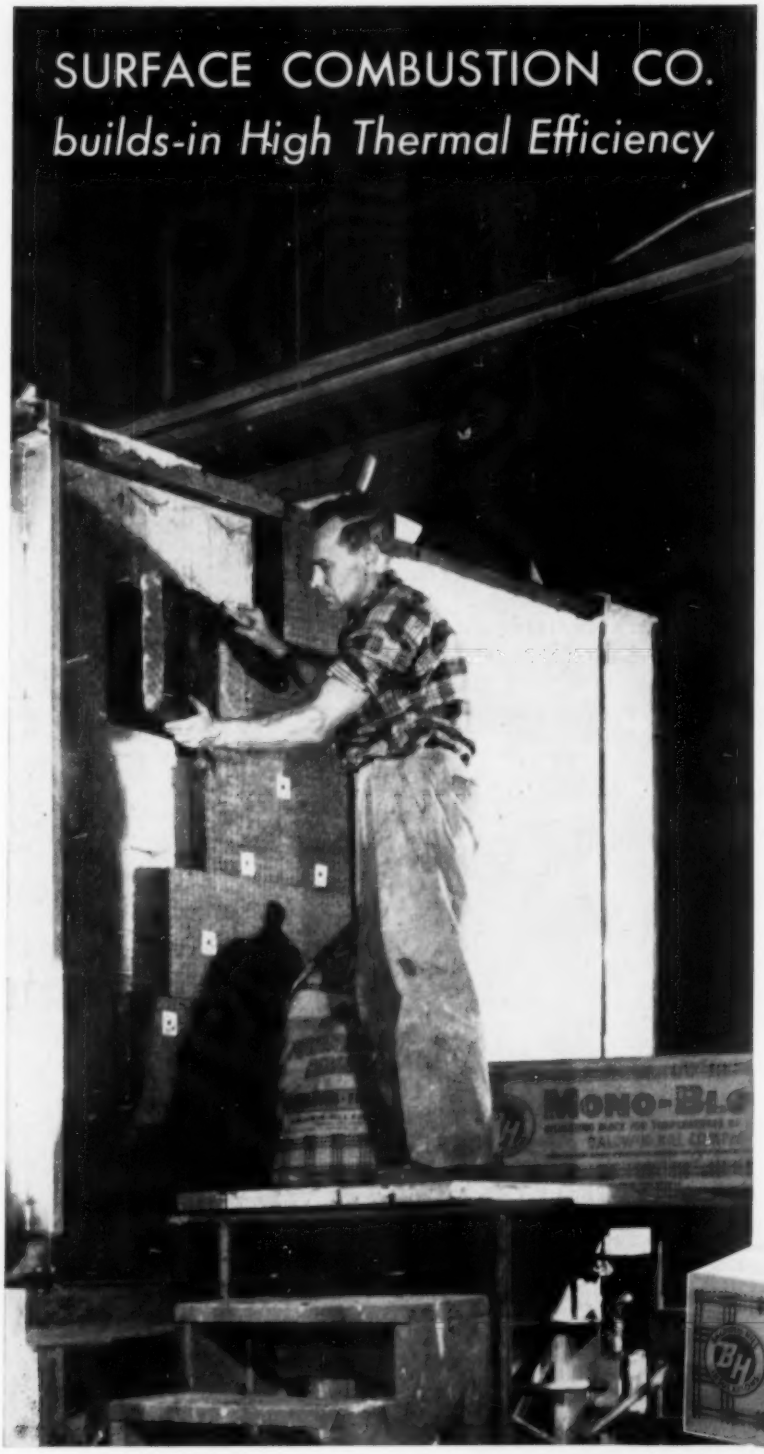
SURFACE COMBUSTION CO.
builds-in High Thermal Efficiency



and also gets
Easy Installation
by using

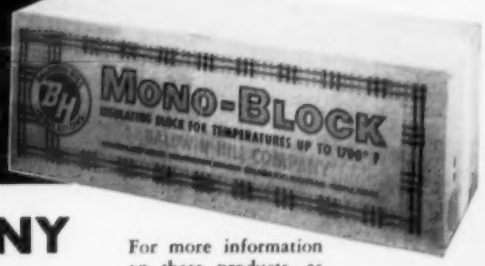
BALDWIN-HILL MONO-BLOCK®

In building high temperature processing equipment like this gas generator, Surface Combustion Co. demands maximum thermal efficiency from insulation along with a minimum of application problems.

B-H MONO-BLOCK fills these requirements, not only through low thermal conductivity over the full temperature range to 1700° F., but by its exceptional ease of handling and installation. In this application, MONO-BLOCK was simply impaled over pre-welded studs and secured by speed clips.

The smooth, white glazed finish, shown at the right of the photo, was obtained with a single coat of B-H SUPER POWERHOUSE CEMENT which eliminates the need for separate insulating and finishing cements.

See our catalog in Sweet's Plant Engineering File.



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Complete line of Industrial Insulations

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For more information on these products, as well as other B-H Insulations, just staple the keyed corner of this ad to your letterhead and mail.

J-311

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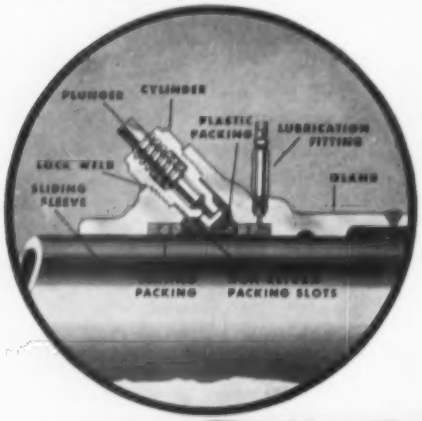
new savings

for expansion joint users

Cross-section of Gun-Pakt feature. To add packing, just add a plug and turn the plunger. Note non-return packing slots at bottom of cylinder.



The Yarway Type W Gun-Pakt Expansion Joint has an improved one-piece design of body and gland and improved method of packing that provide new maintenance economies and greater operating efficiency.

Bolted joint between body and gland is eliminated; the steel body includes gland and guide. Shorter face-to-face dimensions are possible. Improved angle of packing guns makes them more accessible and *permits injection of the special plastic packing directly into packing space.*

The famous Yarway *Gun-Pakt* feature permits *addition of packing under full steam pressure. No need for costly shutdowns to repack.*

Sizes 1½" to 30", pressures 150, 300, 400 psi. Single or double types, flanged or welding ends.

For full description, write for new Yarway Bulletin EJ-1916.

20" Yarway Type W Gun-Pakt Joint with base, single type, welding ends, 8 guns.

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BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY GUN-PAKT

...a good way to specify expansion joints

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A Power Engineer Defines His Job

Persuasive selling talk to group of high school students portrays power engineering as interesting and challenging career. We think this case is interesting and typical; how does it compare with your job?

POWER ENGINEER John S. Cole, Manager of Power Services in Radio Corporation of America's Camden, N. J., plant was asked to make a brief talk to a group of high school students in Collingswood, N. J., a few months ago. The local Citizens' Committee on Education had asked several business and professional people to give the students thumb-nail sketches of their occupations, in an effort to guide the students in their careers.

Mr. Cole has the heavy responsibility of managing a steam generating plant, and delivering power, steam, water, air, and refrigeration to all of the buildings in RCA's big Camden plant. Involved in practically every phase of a power engineer's operation, he is well qualified to impart an excellent description of the activities of one engaged in his field. Since his talk seems to cover the subject so clearly, we quote it herewith:

"We have been asked to talk to you about our chosen professions, to help you in deciding on the choice of your courses of study and on the choice of your future careers.

"My position is that of Power or Utilities Engineer. Manufacturing processes have become so complicated, and so dependent on power, that most companies require an engineer to handle the generation and distribution of the various utilities and services which are required by the many processes. These utilities and services are: electricity for power and light, steam for heat and processing, power generation, water for boilers, sanitary purposes and drinking, water and compressed air for process and manufacturing, and air conditioning for both product control and personnel comfort.

"Some plants purchase all, or part, of the utilities required. Other plants generate a part and purchase the balance of their utilities. Still others generate all of the utilities necessary to operate their plants. In any case, the position of Power Engineer is very interesting, and is seldom in danger of becoming a routine job. The Power Engineer is constantly meeting new conditions and solving new problems. Newer and better methods of supplying and distributing utilities are constantly being invented, so he must read and study all during his career, to keep up with these advances.

"To see what kind of knowledge such an engineer must have, we must mention his responsibilities. He generates and distributes electricity for light and power, so he must be an electrical engineer. He must know chemistry, to get the proper results from burning fuel and treating water for boiler use and process work. He controls the flow of water, steam, and air — so he must have a knowledge of hydraulics. To cool and circulate the air for air conditioning, he must be a refrigeration and ventilation engineer.

"The Power Engineer must be a mechanical engineer so he can select, install and maintain the equipment necessary to generate and distribute the services required by the manufacturing processes. He must be a business man, so he can figure his operating costs and make sure he is running his part of the plant economically. Finally, he must be a teacher so he can instruct those who work with, and for him, in good operation and proper methods.

"As an example of the kind of equipment for which a Power Engineer is responsible, let me mention our plant. It is a medium-size plant; there are many larger, but we burn enough coal every day to heat 30 average six-room houses for a full year. We have our own electrical generating station with six turbine generators. Here we make and distribute enough electricity each day to supply power and light for 450 average homes for one month.

"Our water treatment and pumping plant is large enough to supply the needs of our town of Collingswood, which has a population of 12,000. The big cakes of ice made by ice plants weigh 300 pounds each. Our air conditioning system has the same cooling capacity as would be obtained from melting 10,000 big ice cakes every day. Our daily cooling requirements would supply all of the refrigerating capacity required in a city of 8,000 homes for a full week.

"To prepare for a position as a Power Engineer, the student should take a college preparatory course in high school, with special emphasis on mathematics, general science, physics and chemistry. At college the student should take a course in either electrical engineering or mechanical engineering.

"Building a career is very like building a house. First, a foundation is laid, then the walls and roof are erected, and finally the finish and trim are applied. Your high school courses are the foundation of your career; the superstructure is your college course. The finish and trim can only be obtained in operating practice, by utilizing the knowledge gained during your school years."

(Editor's note: Obviously, John Cole feels that power engineering is a very pleasant and challenging occupation; we agree.) THE END

JOHN S. COLE is a graduate of the U. S. Coast Guard Academy, New London, Connecticut. He later left the service with the rank of Lieutenant (j.g.), to serve as an Operating Engineer for the Boston and Albany Railroad. Later, he became an inspector of boilers and machinery for the Hartford Steam Boiler Inspection and Insurance Co; in this capacity, he also gained additional schooling in mechanical engineering at Lonell Institute of MIT.

Turning once more to ships, John became Ships Engineer and Guarantee Engineer for New York Ship Building Corp; there he was also in charge of the training school for mechanics and operators. From this position, he next became Maintenance Engineer, Power Division, for Socony Mobil Oil Co, in their Paulsboro, N. J., refinery.

Radio Corporation of America needed an Assistant Superintendent of Power, and found that John Cole's background was exactly what they needed. From the position of Assistant, he rose to his present job of Manager, Power Services.

A typical Power Engineer? Yes, we think so.

Fig. 1. Containment sphere of the Dounreay reactor silhouetted against the northern sky on the rocky coast of Scotland

DOUNREAY— Britain's Fast Reactor Project

AT THE VERY EDGE of just about the northernmost tip of Scotland, on a bleak stretch of land exposed to the full fury of both North Atlantic and North Sea gales, a bold and ambitious project is rapidly approaching completion. This is what is known in England as the Dounreay Establishment — an important part of Britain's vast industrial nuclear power project which has been mapped out for the next ten years.

As is well known, last October, Calder Hall, Britain's first large nuclear power plant, went into operation with an initial generating capacity of 60,000 kw. This is a dual-purpose plant — its primary purpose is the production of plutonium and the electric power a by-product. Calder Hall is a gas-cooled reactor and the first stage of Britain's nuclear power program is based on the use of this type of gas-cooled, graphite-moderated reactor. It is expected, however, that these gas-cooled reactors will be followed by liquid-cooled thermal reactors, and then by reactors with a positive gain factor, that is, by the breeder type of reactor. Such reactors permit a much higher utilization of nuclear fuel resources.

Research and development work on these advanced types of reactors is well under way. As early as 1951 the laboratories at Capenhurst were set up, first for the development of the diffusion plant there but later in the development of sodium technology and related projects. Research and development also has been carried out by laboratories at Culcheth, Springfields, and at Windscale. Now, the Dounreay Establishment is being constructed; its purpose is to investigate the engineering, chemical, irradiation, and safety problems of these reactors on an industrial scale. When the Dounreay *Fast* reactor plant goes into operation early next year it will be the world's first large fast breeder reactor power plant. At present there are two reactors under construction at Dounreay: the Fast Breeder Reactor, and the Materials Testing Reactor. The latter is known as the DMTR (Deuterium Moderated Thermal Reactor).

Despite the fact that the fast breeder will develop 15,000 kw of electric power, it is essentially an *experimental* reactor. From this reactor, which is the third stage in the British program, will come the operating experience necessary for constructing much larger future units. It will also provide advanced experimental data on the behavior of fuel elements, cooling systems, and con-

DOUNREAY has been a subject of interest among nuclear power engineers ever since the project was first proposed some three years ago, not only because of the significance of this undertaking in the scheme of future British power development but because it promises to be the world's first large fast breeder reactor to produce commercial electric power. Until recently few details about the project were released but on May 10, last, the United Kingdom Atomic Energy Authority invited a large number of newspaper and technical magazine editors to inspect the plant and to see for themselves what had been accomplished so far. Fortunately, one of our editors—H. E. B. Anderson of Plant Engineering—was in England at the time, and he was among those invited to Dounreay. Andy brought back the pictures and the material on which this article is based. Of course, in even a five-page article it is impossible to describe all the ramifications of this vast project; but we believe this description of the Dounreay reactor will be of interest to all American engineers interested in nuclear power development.

trol techniques. To construct this reactor and to maintain it once it is in operation, a fuel element factory is required together with chemical processing facilities for re-fabricating spent fuel into new elements. Such facilities are being constructed at Dounreay. Facilities will also be needed for the recovery of residues and the treatment and storage of radioactive effluent essential in the fuel cycle, and for analytical control in the various plants. These are all being provided. When the appropriate point in the development of the project is reached, the thermal output of the reactor will be linked to a 15-Mw electric generating plant. The main purpose of the reactor, however, is experimental.

Complete Establishment

The fact that Dounreay is an experimental establishment should be clearly understood. Usually the name, Dounreay, is associated only with the fast breeder reactor, but this unit is only a part of the project as a whole. As already indicated, the project includes a materials testing reactor, a fuel fabricating plant, together with chemical re-processing, disposal and health facilities. Research and development in special reactor experiments is already proceeding in the Experimental Criticality Group on the site. The fabrication of nuclear fuel elements utilizing new and improved fuel materials, including plutonium, will be developed not only for the fast breeder reactor but also for existing and future reactors under consideration by the Industrial Group.

The Fast Breeder

The Dounreay fast reactor is a reactor in which most of the fissions are caused by neutrons moving with the high speeds they possess at the time of their birth in fission. In a thermal reactor the neutrons are slowed down by some sort of moderator before they cause fission in uranium nuclei. A fast reactor has no moderator. The Dounreay reactor will use enriched uranium or plutonium as fuel in the core, and natural uranium or thorium as the fertile material in the blanket. More fissionable material will be formed in the breeding blanket than will be *burned* in the core.

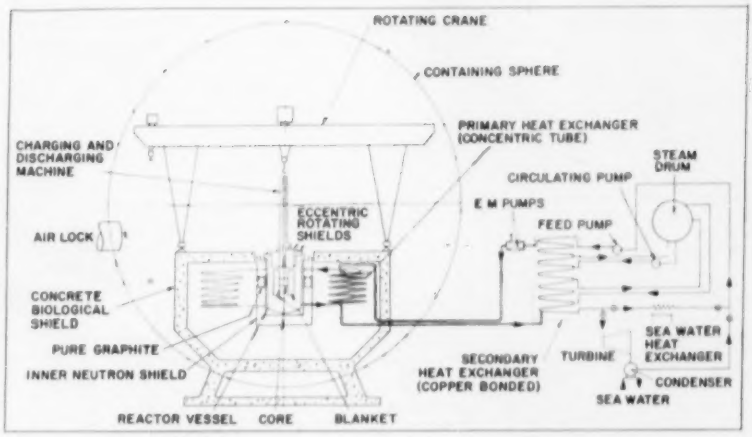


Fig. 2. Schematic arrangement of the fast reactor showing system components

The schematic arrangement of the fast reactor plant is shown in Fig. 2. The reactor core containing the enriched uranium fuel rods in which the majority of the fission processes occur, is surrounded by a blanket of fertile material which serves to reflect neutrons back into the core as they try to escape and in which fresh material is generated. The main heat generation occurs in the central portion, the core proper, which is in overall shape, a hexagonal prism 21 in. high and 21 in. across the flats, made up of several hundred fuel elements of annular cross-section. These fuel elements consist of enriched uranium rods, sheathed in niobium (columbium) containers arranged vertically in a closely packed array. Each contains at both ends a length of natural uranium which acts as a blanket or breeder material. The blanket is completed by surrounding this central core with approximately 2000 natural uranium rods 8 ft long and $1\frac{1}{4}$ in. in diameter.

Niobium is used to contain the core elements because it has a high melting point and good resistance to hot uranium and sodium. Stainless steel is used for canning the blanket elements since the conditions in the blanket are less severe than in the core. Nevertheless, these "less severe" conditions are, in the case of the blanket elements nearer the reactor core, more severe than those experienced by *thermal* fuel elements.

The reactor core and breeder blanket are housed in a stainless steel pot known as the reactor vessel. This vessel is the heart of the plant. It contains the core, the blanket, control-rod operating mechanisms, the recording instruments which measure the activity of the reactor, and the liquid metal which surrounds the fuel and which is circulated through the stainless steel circuits of the primary heat exchangers. The heat generated in the reactor is removed by the liquid sodium-potassium coolant which flows down over the core and blanket and then transfers it to a secondary liquid metal system through a series of concentric tube heat exchangers located inside the reactor vault. This vault, as shown in Fig. 2 is a concrete structure in the lower part of the containment sphere. It supports the reactor vessel and houses all the heat exchangers and coolant pipework associated with the primary cooling loop of the reactor core and breeder.

After absorbing the heat from the primary system in the concentric tube heat exchangers, the secondary liquid metal coolant passes out of the reactor sphere through stainless steel pipes to the Heat Exchanger House. Here the heat in the secondary liquid metal coolant is transferred to water in a set of copper-bonded heat exchangers of novel design. The steam produced in these heat exchangers will drive the 15-Mw turbo-alternator located in the Turbine Hall at the rear of the Heat Exchanger House.

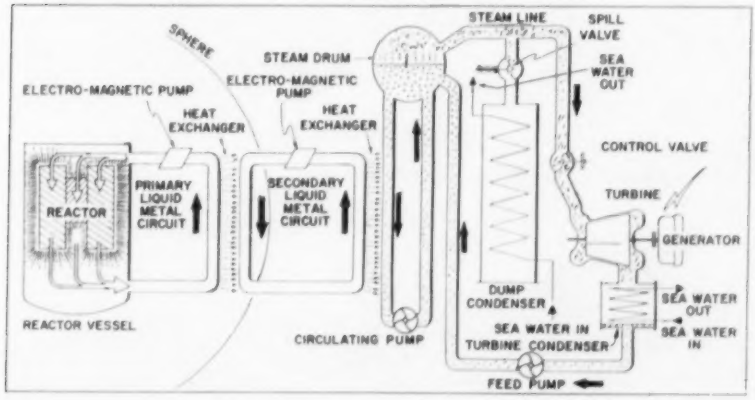


Fig. 3. How the reactor heat energy is converted into electric power

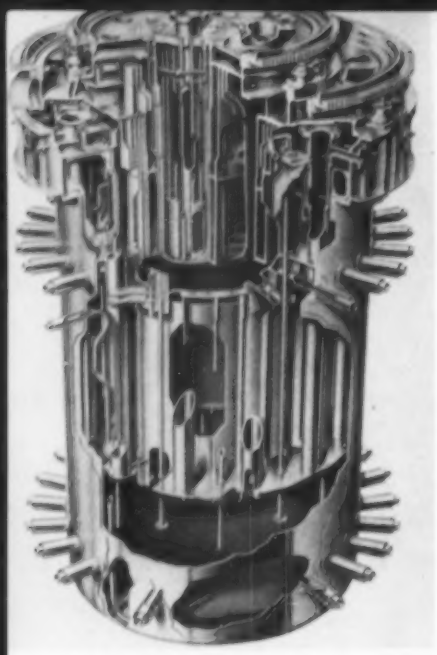


Fig. 4. The 45-ton reactor vessel is the most complicated stainless steel vessel ever manufactured. Sectionalized perspective shows its complex nature

Fig. 2 shows how the reactor heat is converted to electric power.

The Link Building, adjacent to the Heat Exchanger House, contains electrical equipment and switchgear primarily for instrument supplies. There is a diesel generator house containing two groups of diesel-generator sets, one of which supplies electric power to all pumps and equipment in the main reactor cooling circuits. The second group serves as stand-by electric generating capacity for auxiliary reactor plant equipment in the event of failure of the National Grid supply.

On the sea coast, about 100 yards from the reactor is the Seawater Pump House. In it are four diesel driven pumps which supply sea water for cooling the condenser of the 15-Mw turbine.

Containment Sphere

Although Dounreay is located in a remote area on the sea coast, away from heavily populated areas, every effort has been made to prevent the spread of fission products formed during reactor operation or through accident. To contain such fission products, the reactor and primary heat exchange equipment is housed in a steel sphere 135 ft in diameter. This sphere serves two purposes. First, it will localize the spread of fission products formed during reactor operation should they accidentally be released within the sphere. Secondly, it has been designed to withstand any pressure-variations that might occur as a result of a liquid metal fire within the sphere. Such an occurrence should not increase the pressure inside the sphere by more than 18 psi or reduce it more than 3 psi. The sphere is, in fact, one of the largest pressure vessels ever built.

Access to the sphere is through an air lock 40 ft long and 16 ft in diameter with airtight doors at each end. It permits entry to the sphere via the adjacent Element Storage Building at the level of the mid-point of the sphere. To prevent any radiation hazard inside the sphere, the reactor and primary coolant circuits are contained in the concrete biological shield, the Reactor Vault already mentioned. This vault is in the form of a bowl 90 ft in diameter and 45 ft high, with 5-ft thick walls.

Further shielding is provided around the reactor vessel to prevent the secondary liquid metal coolant and pipework within the reactor vault from becoming radioactive. This shielding consists of a 4-ft layer of borated graphite in which an equatorial region of pure graphite permits fission rate measurements to be taken.

Reactor Vessel

The reactor vessel which was manufactured by John Thompson, Ltd, is the most complicated stainless steel vessel ever produced in Britain, probably in the entire world. It took 18 months to manufacture this vessel. While the reactor core is less than 2 ft high and 2 ft in diameter, the vessel containing the core and associated equipment is 20 ft in height by 14 ft overall diameter. Obviously, this vessel had to be absolutely leak-proof; every welded joint had to be examined by x-ray or gamma ray over its complete length. The extent of the radiographic work involved can be judged from the number of x-ray or gamma-ray negatives taken. For the reactor vessel alone about 3750 negatives were taken. For the primary heat exchange system 45,000 were required.

Tolerances called for in the fabrication of the vessel were quite outside normal practice, requiring maintenance of such limits as 0.1 per cent circularity, 0.03 per cent alignment and almost perfect concentricity where several diameters were concerned. Final pressure and mechanical testing in John Thompson's Works were carried out with the contained vessel assembled complete with top shields and supported in a mounting specially erected for the purpose.

Some idea of the astonishing complexity of the reactor vessel can be had from the sectionalized perspective drawing in Fig. 4. It consists of a double-walled cylindrical outer vessel with domed bottom and flat top, with a smaller inner cylindrical skirt reaching to about two-thirds of the depth of the outer vessel. The inner skirt contains the core, blanket, and control rods. Between the periphery of the skirt and that of the outer vessel are a series of tubes and narrower pipes running from the top of the vessel to various levels below the base of the skirt. These tubes carry the operating mechanisms and connections for the control rods and instruments which will enter the core area from the bottom of the skirt.

At the tops of the pipes, instrument boxes are welded in position and pipes carry connections from these out through the wall of the vessel. Similarly, pipes from the control-rod mechanism tubes carry connections from these through the upper wall.

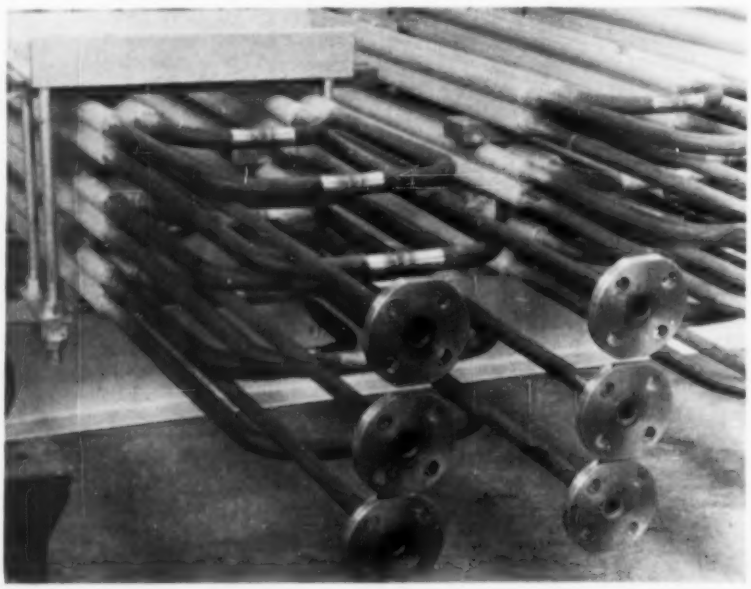


Fig. 5. Secondary heat exchanger elements. Water tube surrounded by 4 liquid-metal tubes, the 5 tubes mounted in close-packed copper laminations

The double walls of the outer vessel are of ¼ in. and ½ in. plate with a ⅛ in. air gap between, forming a jacket around the vessel which will be gas-filled in connection with the leak detection system. At two levels around the vessel there are stubs to which the ingoing and outcoming liquid-metal pipework will be welded. The inlet is at the upper level. Within the vessel the flow divides. A certain proportion passes through the blanket area and does not mix with the main body of the coolant, being led to four of the outlet stubs at the lower level.

The top of the vessel is a complex arrangement of rotating shields or plugs, graphite filled and dispensed eccentrically one within another so that a limited opening in the inner shield can, by movement of the rotating elements, scan the whole area of the core and breeder blanket. Rollers mounted on pads on the vessel carry the outer shield which in turn has roller pads carrying the inner shield mounted eccentrically within it.

During operation of the reactor the rotating shields are raised off their rollers by a jacking mechanism so that the heavy rings which form their periphery make a firm seal with machined surfaces on the member on which they are mounted. In addition liquid seals are maintained between each rotating part during charge and discharge operations by double cylindrical skirts on each shield which mate with it, and rotate within, complementary parts on the members on which they are mounted.

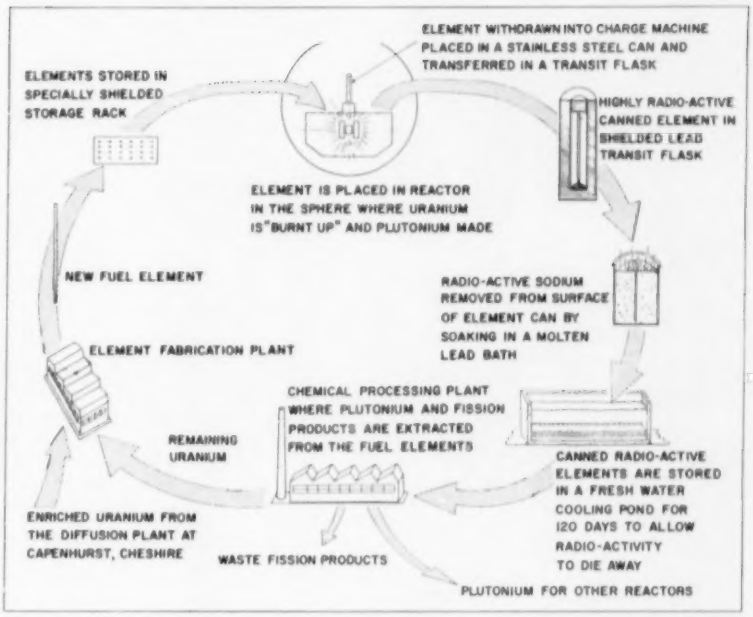


Fig. 6. Here is the life cycle of fuel elements for the Dounreay fast reactor

Heat Exchange Systems

Use of liquid-metal circuits and liquid-metal to liquid-metal heat exchangers for the fast breeder reactor has necessitated special fabrication techniques in stainless steel in order to meet all the conditions required.

Primary heat exchangers surrounding the reactor vessel and contained within the biological shield or vault are in 24 banks. The exchangers consist of inner and outer tubing spaced concentrically by spiders. The inner tubing forms the primary circuit connected to the vessel. The outer tubing forms the secondary circuit which passes out of the vault to the secondary heat exchangers. The primary circuits are each provided with an independent electromagnetic pump and cold-trap purifiers and are paired to serve 12 secondary circuits. This general arrangement is shown in Fig. 2. The secondary heat exchangers are located in the Heat Exchanger House where they produce the steam for the turbine. Any steam generated in excess of the turbine requirement spills automatically into dump condensers cooled by sea water. These can absorb the full reactor output if the turbine is not running.

The liquid metal is circulated by electromagnetic pumps having no moving parts, the only maintenance required being the care of the insulation of the windings. These windings can be removed without opening the liquid-metal system. In the primary system this is done by remote operation through the biological shields. The system contains no valves nor any other parts requiring mechanical maintenance.

Complete failure of the heat removal plant would very quickly result in overheating of the reactor, and to prevent such a failure the heat removal is shared among 12 independent and identical units. A unit comprises two primary liquid-metal circuits, one secondary liquid-metal circuit, a steam raising plant and a dump condenser. Each unit has an independent electrical supply from its own diesel alternator so that the possibility of large scale electrical failure is remote.

If, in spite of these precautions, a widespread failure of heat exchange plant occurred, it would not be sufficient to shut down the reactor because some heat would continue to be generated by fission product activity after shut-down. A thermal syphon system is therefore provided which uses no electrical power but relies solely on convection effects to dissipate heat to the atmosphere. Convection causes a circulation in the primary liquid-metal system from which heat is transferred to liquid metal in the thermal syphon. This liquid metal is also circulated by convection and transfers its heat to the atmosphere through heat exchangers in the stack.

The heat exchangers which transfer the heat from the primary coolant circuits to the secondary circuits, as already mentioned, are all of the tube and annulus design. These are located in the vault. The heat exchangers in the Heat Exchanger House which transfer heat from the secondary liquid-metal circuit to the water to produce steam, however, are of quite different design. Since liquid sodium reacts violently with water every precaution had to be taken to prevent leakage from one system into the other, that is, liquid metal into water or vice versa. This required the development of techniques to enable the complete system to be built as butt-welded units with argon-arc slag-free seal runs.

The design and manufacture of the boiler plant involved the production of a secondary heat exchange system between the liquid metal and water that would be a slave to the reactor. Whereas the temperature rise through the reactor depends on load and liquid-metal flow, the operating temperature level is controlled solely by conditions in the secondary heat exchange and steam plant. With this in view, the plant is designed to give utmost reliability by the use of 12 separate small boiler units, each serving one of the secondary liquid-metal circuits (and therefore, two of the primary heat exchangers), and by the duplication of most of the auxiliary equipment by providing stand-by plant.

These boiler units will control the temperature of the reactor by rejecting heat from the system either to a sea-water dump-heat-exchanger or partially to this dump-exchanger and partially to a turbine. They are arranged to operate by rejecting heat either from water or from steam. By the use of a by-pass in the dump-exchange system the amount of heat dumped, and therefore the operating temperature, can be variably controlled. Superheaters and economiz-

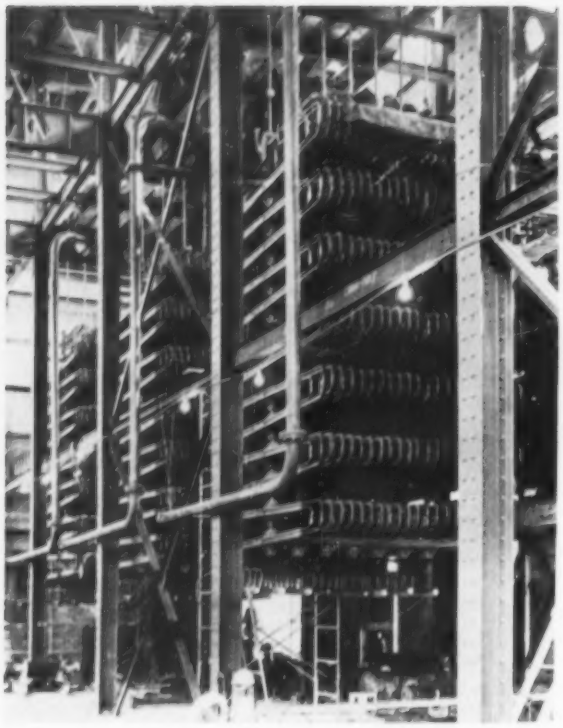


Fig. 7. The secondary heat exchanger units being installed at the Dounreay Fast Reactor Plant

ers are incorporated and can be isolated or brought in to suit the requirements of water dumping or steam dumping.

The 12 heat exchanger units each comprise a steam water drum approximately 4½ ft in diameter by 4 ft 3 in. long with water feed boxes and steam separator, operating in conjunction with seven banks of three heat exchange units.

The elements each consist of one water tube surrounded by four liquid-metal tubes, the five tubes being mounted in close packed copper laminations which provide heat conductivity while also providing a means of directing any possible leakage from liquid-metal tubes away from the water tubes, and vice-versa.

Turbine-Generator Unit

The design of the turbine is generally similar to that of the standard General Electric Co Ltd single casing machine but it incorporates a number of special features on account of the unusual steam conditions imposed. Inlet steam will be at the comparatively low pressure of 150 psig and temperature of 518 F.

The alternator is a standard 3-phase, 50 cycle, air-cooled machine, rated at 15,000 kw.

Control of the Dounreay Fast reactor is achieved by movement of parts of the core, and, therefore differs from the Windscale and Calder Hall reactors where the control is effected by moving neutron-absorbing steel rods in or out of the pile. Twelve groups of fuel elements located at the corners of the core hexagon form the control rods which may be moved in or out of the core. These fuel elements are held in a metal frame resting on a support arm within the liquid metal, enabling the control rods to be raised into the core to increase its reactivity or dropped below the core to shut down the reactor. A magnetic clutch is incorporated in each control rod drive to allow the drive to be transmitted through the reactor without leakage of fission products.

Control and Instrumentation

Each control rod and its support within the reactor vessel is supported by an electromagnet, so that interruption of electrical supply to the electromagnets allows the rods to fall rapidly out of the core, thereby shutting down the reactor.

As all the 12 control rods are of identical design it is possible that a common fault could develop in the mechanism which would prevent their satisfactory operation in an emergency. To provide a reserve control enabling the reactor to be shut down under these abnormal conditions, three rods containing neutron-absorbing boron may be dropped into the inner row of breeder elements surrounding the core. The design of these boron safety rods differs from that of the control rods, so the possibility of failure at the same time as that of the control rods is remote.

The positioning of the control and safety rods is controlled from the desk in the control room by means of a selector switch and push buttons. Operation of an emergency push button on the desk cuts the current to all the holds-on electromagnets and drops all the control rods and boron safety rods simultaneously. In addition to normal or emergency shut downs controlled by the operator from the control desk, automatic shut down occurs in the following manner:

1. Failure of pressure in the primary gas blanket.
2. High temperature in the center of the core.
3. Low flow of liquid metal coolant through core and breeder.
4. A high level of neutron flux.
5. An abnormally rapid rate of increase of neutron flux.

Chemical Processing

The Chemical Group at Dounreay consists of four main sections as follows: Fuel Element Fabrication; Chemical Separation and Billet Production, Effluent Disposal; and Chemical Analysis. This plant effects the complete separation of the plutonium and remaining uranium from the spent fuel elements, and the concentration and disposal of the radioactive wastes. After separation the uranium is formed into billets and returned to the Fuel Element Plant.

As indicated at the beginning of this article, the Fast Breeder Reactor which has been described here is only one element of the Dounreay Establishment. It is however, the most important one since it will be the first large fast breeder plant to go into operation, and for that reason, of great interest to nuclear power engineers the world over. Very little has been said here about the many complex construction problems which had to be solved, particularly in the preliminary stages of the project. Of particular difficulty was the construction of the low active effluent discharge tunnel. While the highly active liquor wastes at Dounreay are stored in stainless steel tanks within heavily reinforced concrete underground vaults, the low active effluents, after retention for a period in special tanks to allow the activity to decay to a sufficiently low level, will be discharged into the sea via pipe lines laid along a tunnel excavated some 70 to 80 ft below the sea bed. Because of the fissured nature of the rock, the drilling of this tunnel was an extremely difficult undertaking.

Although Dounreay was only started in 1955, it is expected that the fast reactor plant will be completed around the middle of 1958.

LOOK FOR NEW ATOMICS SECTION IN DECEMBER ISSUE

Beginning in the December issue a new special section devoted to the use and development of nuclear energy throughout the world will appear in every other issue. It will cover all aspects of nuclear development in language that practical engineers can understand.

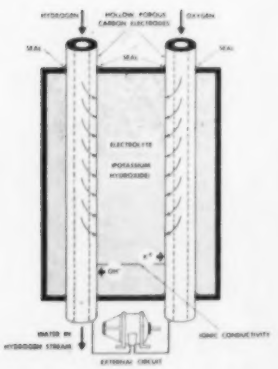


Fig. 1 (r). Dr. Karl Kordesch, National Carbon Co researcher, demonstrates fuel cell. Nine hollow, porous electrodes are grouped in plastic housing. Carbon header on each end channels hydrogen and oxygen gases. Electrical connections conduct away the power. Potassium hydroxide is electrolyte for the electrochemical reaction (Fig. 2, above)

Enter the Fuel Cell, New Power Source

DIRECT CONVERSION of the chemical energy of gases into electricity — long a dream of scientists and for years a laboratory curiosity — has been accomplished with the development of the first fuel cell capable of economically producing thousands of watts of power. Using hydrogen and oxygen as fuel, the new silent source of power has been developed by scientists at the research laboratories of National Carbon Co, a division of Union Carbide Corp. Here's how it works (Fig. 2, above):

Hydrogen and oxygen gases enter the cell through specially-treated, hollow, porous carbon electrodes, and diffuse to the surface where they come in contact with the electrolyte, a solution of potassium hydroxide.

At the hydrogen electrode, the electrochemical reaction releases an electron, which flows through the external circuit and is accepted at the oxygen electrode. This flow of electrons is the current that powers electrical equipment. Ionic conductivity through the electrolyte completes the circuit, and the water formed in the reaction passes from the cell in the hydrogen stream.

Secret of the new fuel cell's success, according to its developers, is the chemically-treated, hollow carbon electrodes through which the gases enter the cell, and which also conduct the electricity produced.

The cell is designed to work at ambient temperatures and at approximately atmospheric pressure, and does not depend on high temperatures or pressures for efficient operation. It thus eliminates the need for heavy, costly pressure vessels. If increased output is desired, it can be obtained by increasing the pressure.

With the water disposed of by evaporation, the life of the cell is theoretically unlimited. Cells have been operating in National Carbon's lab eight hours a day, five days a week for the past year, with no signs of deterioration.

Efficiency

Production of electricity directly from hydrogen and oxygen in the fuel cell is inherently more efficient than its production in a conventional steam system in which the heat is supplied by burning these same gases. Practical limitations in utilizing all of the heat produced reduce the over-all efficiency of a steam system to about 30 or 35 per cent, while a fuel cell, which eliminates the intermediate heat step and converts directly from chemical to electrical energy, has a top efficiency of about twice that figure.

Operation of the new fuel cell at ambient temperatures results in high efficiency. The cell's normal operating temperature ranges from 120 to 140 F. Efficiency of operation depends on how the cell is used, but the general efficiency range is from 65 to 80 per cent when operated at normal temperatures and pressures. Research and development to date indicate that the optimum fuel cell design will be one which will produce approximately 1 kw of power from a package unit 1 cu ft in volume.

Voltage across the electrodes is about 1 v, and it is simply a matter of connecting a number of cells in a circuit to get any voltage desired. The amount of electrical current produced by the cell depends on its physical size, so by varying the number and size of cells, many combinations of voltages and currents can be obtained. Basically, the fuel cell is most desirable for high current, low voltage use.

Operation on Air Possible

Although pure oxygen is required for higher current densities, the new cell can be operated with hydrogen and air for producing smaller amounts of power. The new design also permits operation with hydrogen containing considerable impurities, which means that standard industrial grades of purity can be used.

As a practical producer of electrical energy, the new fuel cell depends on an economical source of hydrogen, a gas that at present is quite expensive and requires relatively bulky pressure vessels. Possible hydrogen sources include coal, which yields hydrogen when exposed to steam in the water gas reaction. Ammonia is another possible source, and the catalytic cracking of petroleum products can also produce hydrogen.

Most immediate applications of the cell are expected to be: military communications systems, mobile power units, standby plants. THE END

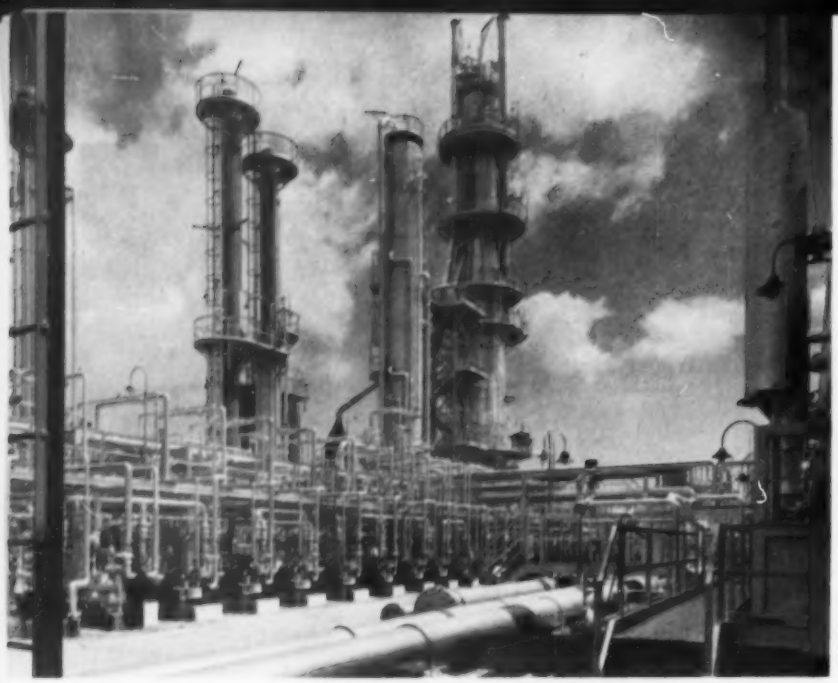


Fig. 1. (Left) Modern refinery with 50 small turbines, 8 large ones ranging up to 5000 hp. Fig. 2. Single-stage high-pressure unit, powerful but inefficient, makes reliable standby feed pump drive

Mechanical-Drive Steam Turbines Serve Industry Well

By **HALL STEEN-JOHNSON** *

BEST DEFINED in a negative manner, the mechanical-drive steam turbine is a turbine that is not used to drive an electric generator. This approach is perhaps indicative of the situation in which this steam turbine finds itself today: somewhat overshadowed by its more common and better-known relative, the turbine-generator.

Actually, thousands of these turbines drive pumps, fans, compressors and line shafts in such varied industries as steel, petroleum, chemical, and pulp and paper. Frequently, in large buildings such as the new Coliseum in New York and the Merchandise Mart in Chicago, you will find them driving the air-conditioning compressors.

Horsepowers range from 5 hp up to the drives for the large 15,000-hp blast-furnace blowers in the steel mills. The usual speed is 2000 to 4000 rpm, but many operate at 8000, 10,000 and even 12,000 rpm, and a few specials higher than that.

These turbines provide the means for converting heat energy directly to mechanical work without going through the step of converting it to electrical energy, then by motors back to mechanical energy.

Just a few statistics will illustrate the extent of this field. There is much publicity about the expansion of the power industry, in particular the large units going into the various utilities. Considerable glamour is attached to the super pressures and the very large units. Current expansion is around 7,000,000 kw each year, but in addition to this much-publicized expansion, industry is adding close to 1,000,000 hp each year, and approximately 45 per cent of this is for direct mechanical-drive units.

Small Units

Taking a look at this broad field we start at the small end with the single-stage unit, as in Fig. 3. This is a single-valve unit, and frequently runs on low-pressure steam. Steam is admitted on the right under the trip valve, is controlled by the gov-

*Chief Turbine Engineer, Elliott Co., Inc

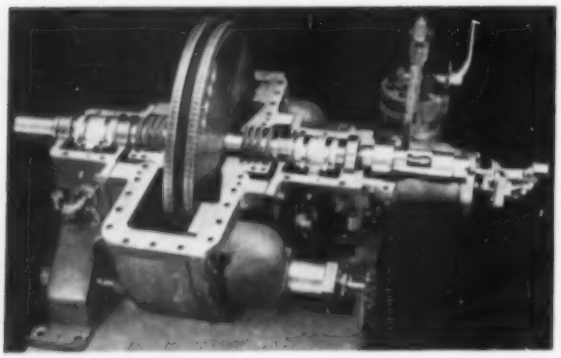


Fig. 3. Single-stage, single-valve low pressure steam unit

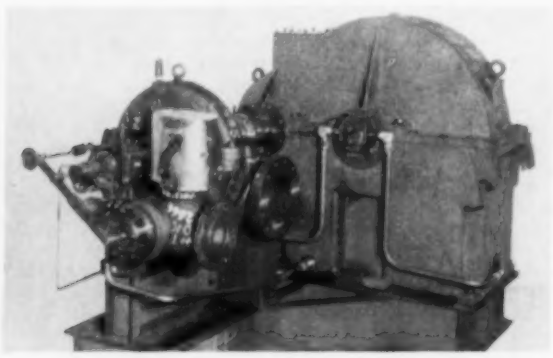


Fig. 4. Small, powerful turbine drives large reducing gear

ernor valve and enters the nozzle ring where the hand valves are located. Then it expands through steam nozzles into the blading. The exhaust is on the far side.

The bearings are liner type with oil rings and the shaft is sealed by carbon rings. A flyball type of governor is mounted on the shaft and actuates the governor valve.

In order to cover the power range with these small turbines they are made in different frame sizes, the basic difference being the diameter of the turbine wheel. Diameters are available from as small as 14-in. up to 28-in.

The machines can be either condensing or non-condensing types. In general the efficiency is not high because all the expansion is absorbed in one single stage. Efficiencies run from 30 per cent for the condensing machines to around 50 per cent for non-condensing.

For the majority of pump applications, the pump is coupled directly to the turbine, but on large fans and reciprocating compressors a gear is generally used. Figure 4 shows such a gear, with the turbine, steam inlet, connection from governor to governor valve, and exhaust flange. The most startling point, of course, is the relative size. The little turbine on the big gear illustrates the advantage of speed — how we can get power in a small package when we accept high speed. After all, the fundamental energy expression has speed to the second power.

Single-Stage High-Pressure

While most of these single-stage units are for low-pressure steam, application as boiler-feed-pump drivers sometimes boosts the steam pressure, and the configuration changes. Figure 2 shows a unit for 900-psig steam, and there is a radical change in the steam chest. Both governor and trip valve are vertical. Extended valve stem seals are needed. An oil cylinder is used to move the valve. The carbon rings sealing the shaft have been replaced by full metallic-labyrinth packing.

Since the efficiency of the single-stage turbine is quite low, it is justified only in small horsepowers. Better efficiency can be obtained by increasing the number of wheels or stages in the machine. The increased expense is justified by the improved steam rate. As costs rise the dividing line moves lower.

These costs involve both the increased cost of fuel and the increased cost of steam as well as the reduced demands for water that result by operating more efficient equipment. And, of course, if it is possible to increase steam pressures at the same time further improvement will be obtained in economy. Multi-stage turbines can take better advantage of the increased heat available when the steam pressure is increased.

Air Conditioning Drives

Such a multi-stage unit of three stages, evolved from the single-stage unit, retains the steam inlet and valve arrangement, as well as the same bearings and governor setup. This unit in condensing service ups the efficiency from a figure in the 30 per cent range to 50 per cent or better. With more stages, this type of unit can go up to 3000 hp. With 300 to 500 hp it is frequently applied in commercial air-conditioning.

In some of these installations steam for heating is furnished by a central steam system, and the same source can thus be used for summer air-conditioning. In this type of commercial air-conditioning it is noteworthy that almost three out of four installations are operated by steam drives rather than by motor drives.

When the steam flow goes up on the multi-stage machine, the valve begins to be a problem if close control is essential. A better governor arrangement is needed. The need is created by the degree of control required, the pressure and temperature used, and the quantity of the steam flow. So, we turn to a unit using a vertical relay governor.

This change usually introduces a thrust bearing of the Kingsbury type, as well as the vertical relay governor. With the vertical relay an oil servo can be used to handle the valve and give more precise positioning, so that the speed change is smaller, and the valve can handle larger flows and horsepower and make use of external process control.

To take better advantage of the increased efficiency from multi-stage turbines the single-inlet valve can be replaced by multiple valves. This reduces the quantity of available heat lost by throttling at part load. The servo motor that operates the valves is located at the horizontal joint on the center-line brackets.

Comparing this unit to the previous machine and subsequent ones it will be seen that this series of units is developed from components that are put together like building blocks. We find the same wheels and generally the same internal steam parts. The steam-end bearing case is also interchangeable.

Multiple-inlet valves in the steam chest are cast integrally with the turbine casing. They are operated by a bar-lift valve gear. The rotor and steam path components are the same as for the single-valve turbine.

High-Speed Turbine

Trend to higher turbine speeds started a few years ago as a result of new developments and applications of centrifugal compressors. New process applications with higher inlet pressures, higher pressure ratios, and lower volumes appeared, and these conditions push the tip speed on the compressors up, and result in new wheel designs.

The driving turbines for these compressors become high-speed turbines of substantial horsepower. The power requirements start around 1500 hp, with the majority around 3000 hp and some as high as 8000 hp, at speeds around 9000 rpm but up to 14,000 rpm. This makes for a lot of horsepower in a small package and calls for meticulous attention to design details. Tip speeds are up in spite of reduced diameter, and high disk stresses are handled by solid rotor construction, the shaft and disks machined from one forging.

In these single valve units vertical relay governors are used. The

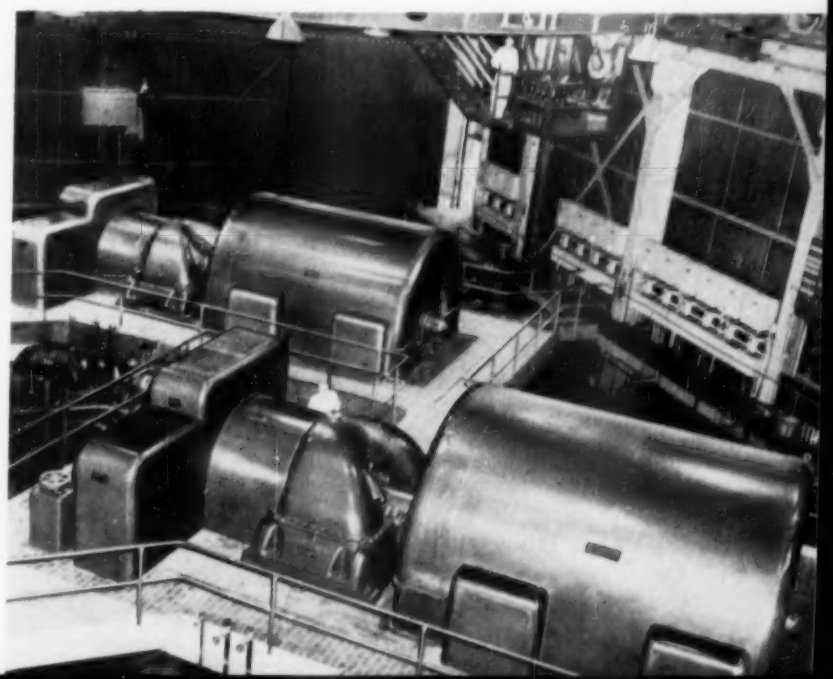


Fig. 5. Not generators! These two steam turbines are driving 100,000-cfm blast-furnace compressors. With compressor nozzles below appearance is deceptive

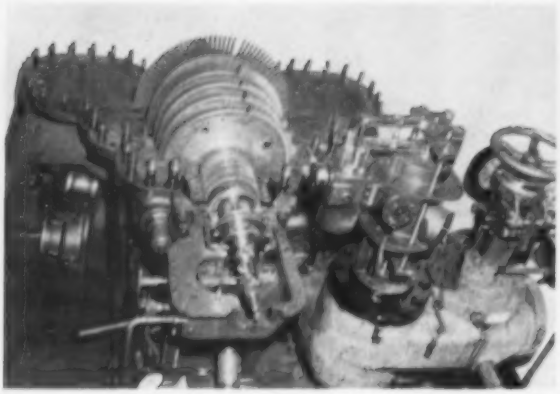


Fig. 6. Internal view of high-speed turbine. Note solid rotor. Steam path is much larger because of higher velocities

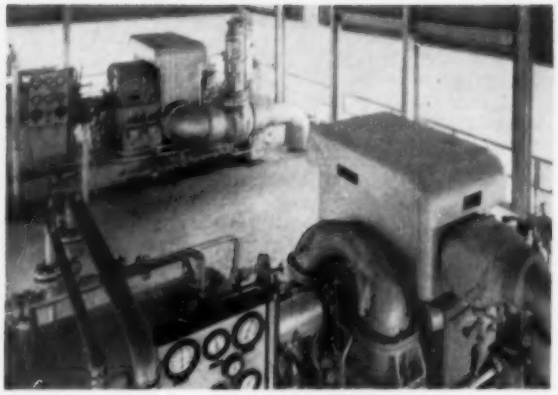


Fig. 7. View contrasts single- and double-flow exhausts. Latter is in background. High throttle valve is chain-operated

inlet valves are arranged vertically and are of the venturi type, operated by oil cylinders.

Carbon rings are retained at the shaft seal, but the application has to be watched. Carbon rings with close clearance are the most effective seal, but they are limited by both temperature and rubbing speed.

The blading becomes quite special at these high speeds and the blade shanks deserve special attention. The intermediate blading is running faster than comparable blading in 3600-rpm generator drives and the low-pressure blading is up to the latest central-station practice.

The last-stage blades for these machines need the full treatment and respect accorded long low-pressure blading. The 5½-in. long blade at 12,000 rpm will have a tip speed of 1520 ft per sec, about the same as a 25-in. blade on a 50-in. drum at 3600 rpm.

This means high load both in the blade fastening and in the vane section. The increased load is taken care of by using multiple hooks on the shank in a pine tree arrangement.

Large Turbine Features

For larger horsepower multiple-inlet valves, bar-lift operators are used. The governor arrangement is the same as for the single valve. In this unit the same solid-rotor construction is used and the tapered blade is used in the last stage.

Carbon packing is used at the exhaust, and at the steam end a combination of carbon and labyrinth. The labyrinth is on the larger diameter where the rubbing speed is higher, and also inside the unit where the temperature is high.

With the high speed in these machines, the steam velocity is also up, and the proportions of the unit change. See Fig. 6. The steam inlet and exhaust seem oversized compared to the blade path and rotating parts. Also note the appearance of the oil servo for the valve and the arrangement of the throttle valve. This unit is 3500 hp at 9000 rpm.

This unit is built with solid rotor and sealed with carbon rings on the shaft. It will be noted that the journal bearings are relatively large in this type of machine. The reason for this is to maintain a heavy shaft in the interest of a high critical speed. Immediately in front of the journal bearing is the thrust bearing which is of the Kingsbury type and further forward we find the worm-wheel drive for the governor assembly. It should also be noted that the oil connections to the bearing case use flexible pipe to eliminate strain when the unit expands during operation.

With a last-stage blade such as discussed the capacity of the exhaust is pushing 5000 hp, under suitable steam conditions. Beyond this point, double-flow exhaust is a solution to more power in the same shaft. And carried to the extreme, with low inlet pressure, the conventionally-seated valve is replaced by a rotating-type grid valve. By low inlet pressure we mean something below 50 psig.

The stationary diaphragm has radial slots and a rotating diaphragm has similar slots. It admits steam in controlled amounts to the nozzles by registering different numbers of slots as it rotates. The oil servo that moves the rotating valve is under governor control. This arrangement is in use on quite a few machines in refinery service.

Installed unit is in the rear of Fig. 7. The pedestal is high and the centerline far up from the floor. The inlet, with 10-psig steam is 20 in. Note how high the throttle valve is, and the chain used to manipulate the handwheel. The double-flow exhaust is fabricated.

The unit in the foreground is a single-flow exhaust, and operates at 8500 rpm on intermediate pressure.

In the more conservative speed range, but with large horsepower, we find the turbines that drive blast-furnace compressors. These furnaces take over 100,000 cfm of air at 30 to 40 psig, and with the new split-wind arrangement, operating more than one furnace from a compressor, the power may approach 20,000 hp.

To effectively control the admission valves regulating the high pressure steam flow, a cam-lift valve gear is used, borrowed from the high-pressure generator drives.

Control of Units

Vertical oil relay governor is also used on the multiple-valve units. The valves are moved by a double-acting oil servo, powered from the main oil supply. The pilot valve controls the oil admission to the double-acting piston and is positioned by the small power piston in the amplifying device, the small pilot servo mounted on the side of the valve servo. This amplifying device picks up the control pressure from the rotating pilot on top of the speed governor.

The control pressure acts on the small piston area of the governor pilot to balance the force of the governor weights. For a speed change the weights move and the oil admission to the control oil line is changed. The change in control pressure will reset the valves through the amplifying device on the servo and will act on the balancing pilot to re-establish balance of forces with the speed-governor force. The speed governor itself is frictionless.

In this design the motion of the governor weights is entirely elastic deformation. The pins are supported in bonded bushings that deflect in torsion. The weight connections to the spindle are springs so there is no relative sliding or rolling with static friction to be overcome. This governor picks up changes of less than three rpm in 3600.

It is readily adaptable to exhaust and extraction controls. The high sensitivity makes it well suited to high-speed turbines when the rest of the speed control system and the valves are properly sized to function in response to the rapid acceleration of the light rotors. In these units the ratio between energy input and the rotor inertia is much higher than for 3600-rpm turbines. THE END

Fig. 1. New plant is 180 by 240 ft, rises six stories. Cooling tower is concealed by vertical louvered wall. Building is windowless, gets ventilation through horizontal aluminum louvers

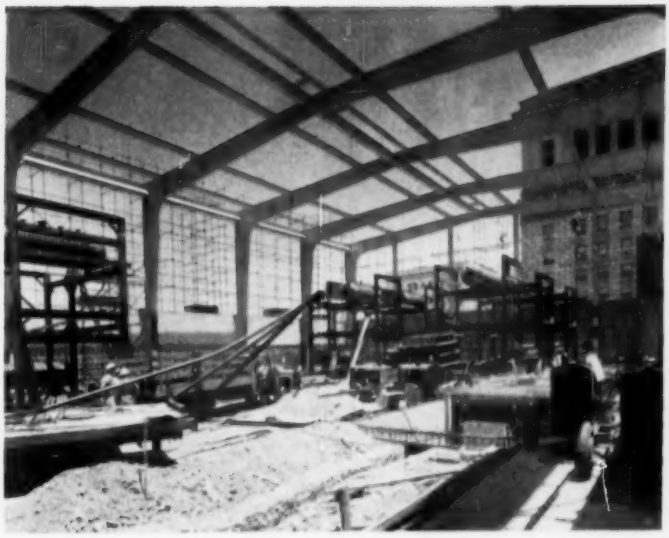


Fig. 2. This view shows steam generating section of plant under construction. Basic frame of boilers and rigid bents are in place, with drums of boilers on framework. Designer was M. A. Nishkian

Central Heating-Cooling System Saves Costs for Group of 9 Buildings

Over a 20-year period, centralized instead of unitized air conditioning system for Civic Center buildings in Los Angeles will slash county heating costs an estimated $2,972,000, cooling costs an estimated $1,603,000. Total saving about equals construction cost of the big new central plant with tunnels for distribution

By JAMES JOSEPH

BIGGEST and most complex installation of its kind, Los Angeles County's central heating and air conditioning plant is scheduled to go into operation in December. Built at a cost of $4,500,000, the plant rises from Los Angeles' burgeoning Civic Center, nine of whose major structures it will serve through the largest of multiple-building feeder-type distribution systems.

Running out from the central plant, 1500 ft of reinforced concrete utility tunnels will link the nine buildings, some existing, some under construction, some in the planning stage. Lying from 15 to 20 ft underground, the tunnels have a dual purpose. They not only serve to distribute the central plant's output, but also pinch-hit as pedestrian walkways (and if need be, as bomb shelters). In addition, they carry some electrical service and telephone lines. Tunnel-distributed are chilled water for refrigeration (45 F supply, 55 F return), 275-psi steam for heating, and softened domestic cold water. Five gas-oil fired boilers furnish a total 120,000 lb of steam hourly.

Steam will both heat the nine buildings and power the central plant's refrigeration compressors (and some auxiliary equipment), achieving a uniquely balanced summer-winter heat load. Four steam turbine-driven centrifugal compressors have a refrigerating capacity of 4400 tons. The central control room and its complex of remote switches so nearly automate the service that only seven operators are scheduled to man the plant.

Centralization instead of unitized heating-cooling for the buildings will, over a 20-year period, slash an estimated $2,972,000 from county heating costs, some $1,603,000 from summer air conditioning expenses. Total savings — about $4,500,000 — equal the construction cost of the central plant and its service tunnels.

Buildings to be served by the system are the Hall of Justice and its annex, Hall of Records, County Law Library, new County Courthouse, and five new structures being planned for the Civic Center, including a new Hall of Records, administration building and county garage. None of the existing buildings has cooling, although several have unitized heating, which will be removed.

Heating Plan and Load Balance

Sixteen thousand sq ft are devoted to the central steam plant. Included are five Springfield water-tube, two-drum water-wall steam generators, each continuously generating 24,000 lb of saturated steam hourly at 150 per cent rating, and capable of 32,000 lb at 200 per cent for periods up to five hours (with feedwater at 220 F). Each has a heating surface of 4640 sq ft. Rated horsepower is 464, operating pressure 275 psig, and design pressure 400 psig.

The steam generators are dual-fueled, gas and oil, but except for interruptible periods will operate gas-fired. The fuels are: commercial grade No. 6 (PS 400) oil or 1100 Btu/cu ft HHV natural gas at 3 psi, preheated to 390 F air.

Each boiler has its own stack (stubbing just above the roof's parapet), a 15-hp forced draft fan to the intake plenum, and a 20-hp induced draft unit from air preheater to stack. Air preheaters have an air inlet temperature of 80 F, an outlet temperature of 392 F. Gas inlet temperature is 550 F, gas outlet (gas firing) 311 F. Forced draft fans are rated not less than 9750 cfm at 4½-in. static pressure.

M. A. Nishkian & Co., consulting engineers, were retained by Los Angeles County to design and engineer the project. Constructor was Haas-Haynie-Frandsen, Inc.

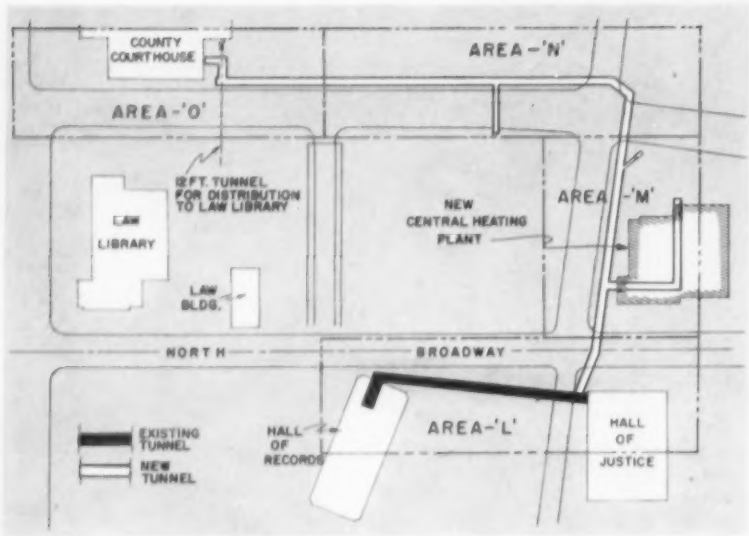


Fig. 3. Civic Center group will eventually include 9 buildings, all served by central plant which sends heating and cooling through 1500 ft of tunnels

Nishkian's guiding principle was that regardless of heating load, steam utilization must be sufficient to allow boilers to operate most efficiently year-around, summer as well as winter.

To this end, he has specified four steam turbine-driven, centrifugal refrigeration compressors to provide the chilled water for summer air conditioning. This provides a sizable summer load for the boiler plant during a period when heating steam requirements are practically negligible, and allows efficient operation all year.

To assure the utmost use of waste heat, two boilers are provided with dual fan drives, steam turbine as well as electric motor. Additionally, one of three boiler feed pumps (rated 125 gpm at 850-ft head) is also steam turbine-powered; so are a fuel oil preheater and fuel oil pump (28 gpm).

Borrowing in-plant steam (much of it usable "waste steam") for some components, especially the more strategic, assures that at least No. 3 and No. 5 steam generators will remain operative even during an electrical outage. These would be sufficient to power the compressors for summer air conditioning, or heat the buildings, should the emergency arise in winter.

Should such an emergency arise, the two generators' auxiliary equipment would likewise continue operative under steam and standby electric power, the plant's standby diesel electric set supplying the emergency voltage. The GM-6-71 generator's 480-v output is keyed to seven essential units, most of them involving the two turbine-powered boilers: boiler feed pumps, diesel oil pump, bearing cooling fans, preheater drive on the two boilers, bearing circulating pumps (bearings are water-cooled), instrument air compressor, and power panel (emergency lighting and control room).

Waste heat use is the key to the plant's winter-summer load balance. Thus the regenerative-type air preheaters pick up some exhaust heat from the stacks, which both preheats boiler air and at the same time lowers exhaust temperatures from a normal 550 F to as low as 311 F when boilers are gas-fired, 345 F when oil-fired.

Again, a continuous boiler blowdown system bleeds-off about 10 per

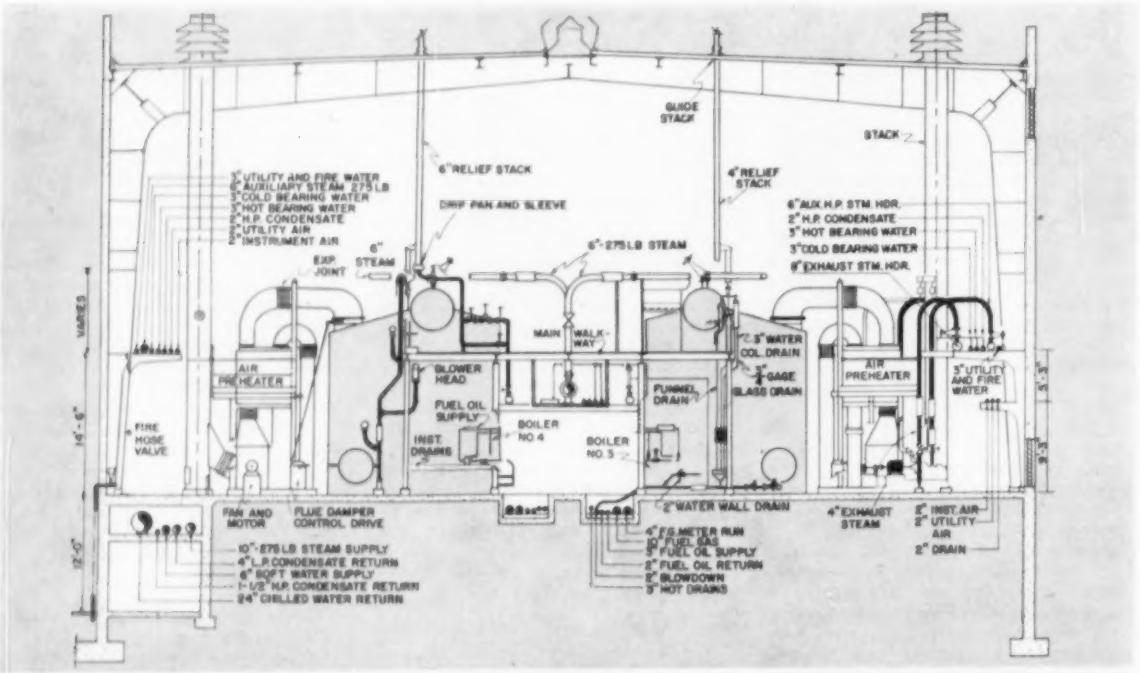


Fig. 4. Section through one area of boiler plant. Five gas-oil fired boilers furnish total of 120,000 lb of steam hourly

Fig. 5. Four steam turbine-driven, centrifugal refrigeration compressors provide chilled water for summer air conditioning. Here they are being erected

cent of the makeup (about 3½ gal) per minute from all boilers. Part of this bleed-off is flashed to steam in a flash tank with a design pressure of 50 psig. The steam, in turn, is used to heat boiler feedwater. What remains goes into a blow-off tank, and from there to the sewer.

Typically, the plant is installed with two deaerating feedwater heaters, these supplied with about 5 psi gage exhaust steam. Each heater's capacity is rated at not less than 60,000 lb per hour.

Plant steam is again put to use to preheat fuel oil. In the fuel oil set-up, oil is stored in two underground tanks, one 50,000 gal, the other 40,000 gal. Oil is transferred from storage to a pumping and heating set by an electric-driven pump, 28 gpm against a 35 psig discharge head. The pumping and heating set is a package unit, heated by 100-psig steam. Fuel oil incoming from storage at approximately 100 F exits heated to 230 F, as required for boiler fueling. Again, of the heating set's two integrated pumps, one is steam turbine-driven, and fitted with a constant pressure governor, emergency overspeed trip and flyball-type of constant speed governor.

Makeup approximates 10 per cent of the steam generated, which translated to gallons amounts to only 35 gpm. Of the four boiler feed pumps, three are motor-driven and one is turbine-powered. Each has capacity of 125 gpm at 850-ft discharge head.

Chemical feed systems are another feature of Los Angeles County's central air conditioning plant. An amine feeder coats condensate and steam lines with a molecular film impervious to oxygen and CO_2. Plant condensate, ranging from 160 to 180 F, dissolves the chemical in the amine tank (capacity about 100 gal). A polyphosphate feeder is timer-actuated, feeding such chemicals as anti-foam lignin mixes, sodium polyphosphate, sodium nitrate and sodium sulfite to the boiler makeup system at 0-3 gpm.

Above the main boiler room floor rises a soundproof, air-conditioned, glass-enclosed control room, flanked on one side by a boiler control panel and on the other by a refrigeration control board. From here a single operator monitors boiler room gaging and metering, refrigeration compressor room operation, and such associated services as domestic cold water softening (installed are four sodium zeolite units, each of which is rated 230 gpm, and their regenerative systems).

Refrigeration Plan

Eight thousand sq ft of the central station are given over to refrigeration. Installed are four Worthington steam turbine-driven, Freon 11, centrifugal compressor units. Two are rated 1300 tons, and two 900 tons. Again, use of plant steam by the turbines assures a heat-balanced load, winter or summer.

Outside the plant, underground and partially extending into it, lies a two-sectional concrete cooling water basin, 35 by 40 ft and 7½ ft deep. It is sectionalized so that one section can be shut down for cleaning without interrupting the service.

Drawings from this basin are four vertical turbine pumps. Two of the units are 200 hp, delivering 3890 gpm at a 130 ft-head. The other two are 150 hp, delivering 2700 gpm at the same head. These pumps circulate water from the basin through the condensers, then over the cooling tower and back to the basin. The tower, roof-mounted, can handle 10,800 gpm. Maximum inlet water temperature is 105 F, outlet temperature about 85 F, for a drop of 20 degrees.

In-plant steam, after powering the four compressor turbines, is routed into the condensers via a 20-in. diameter loop line, and the condensate is returned to the boiler plant. Guaranteed water rate on the turbines is set at 13 lb of steam per ton of refrigeration.

There are four chilled water pumps, all working at 130-ft head, two of them rated 150 hp and 3110 gpm, and two at 100 hp and 2160 gpm. They circulate chilled water from a 2800-gal surge tank, through chillers and into the distribution system via 20-in. go-and-return steel lines distributed to the Civic Center's potential group of nine buildings through the tunnels.

The refrigeration compressors and their auxiliaries are designed to be semi-automatic. They are monitored from the control room, and their operation in large part is controlled from there.

Compressors are manually started or stopped on signal from high or low-temperature alarms. However, once compressors are started up they are automatically controlled over their specific range by a master recording controller actuated by the system's outgoing chilled water temperature. The controller, by means of a pneumatic signal, positions the turbine throttle valve (and each machine's hot gas by-pass) to achieve pre-set outgoing temperatures.

Pumps circulating chilled water through the system are manually put on and taken off the line. The number of pumps needed is indicated by a combination pressure-flow recorder mounted on the constant pressure by-pass. When system pressure falls below the set pressure, an alarm sounds, indicating that there is need for an additional pump and cooler on the line.

Like all other plant metering devices, the pressure-flow recorder is banked on the refrigeration master control panel in the control room. Among the centralized control devices are the following: pressure and flow recorder from the chilled water distribution header, electronic resistance temperature recorders on chilled water supply and return headers, and Btu meter; pneumatic-transmitted recorder of steam flow and pressure; turbine speed controller; condenser circulating water flow recorder; chilled water by-pass flow recorder; and sixth, chilled water temperature recorder-controller.

Refrigeration units are supplied with two types of chemical feeds: concentrated sulfuric acid, from a 5000-gal underground tank, which automatically maintains pre-set pH levels in the circulating water basin via a 1½-gpm chemical pump; secondly, sodium hypochlorite which is "shock fed" by a timer every 24 hours to the cooling tower, in this way maintaining 2 ppm chlorine for algae control.

Tunnel System

Fifteen hundred ft of underground distribution tunnels will service the nine buildings. Supported on roof-hung structural steel beams or expansion rollers are seven distribution lines: two chilled water supply and return lines (steel) for cooling; two steel steam lines, supply and return, which carry 275-lb steam for heating the buildings; copper cold water line, distributing softened domestic cold water; pump condensate return line operating at 180 F; high pressure condensate return, returning condensate to plant's deaerating feedwater heaters.

Los Angeles County's new centralized plant, with its application of feeder service to such a large complex of buildings, is an outstanding achievement in power engineering.

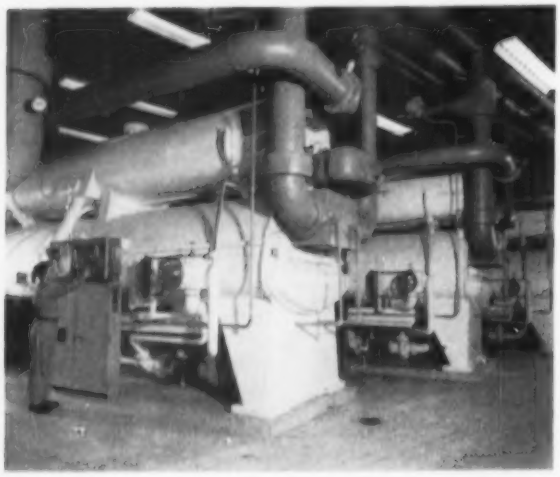
Comparable, though smaller, is the multiple building feeder layout of the Canners' Cooperative plant on Terminal Island at Long Beach, Cal. This, too, was designed by M. A. Nishkian.

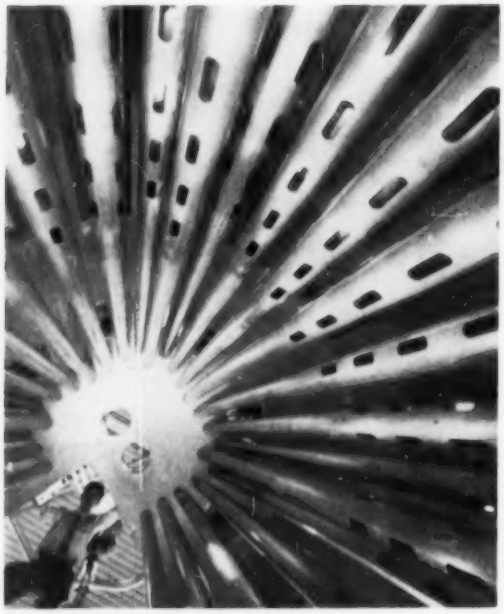
A somewhat similar one-building operation has been designed into the Coliseum in New York City. THE END

POWER ENGINEERING'S

Under Mountain Powerhouse with 5 generators capable of producing 1,000,000 kw of electricity is being built for Aluminium Ltd at Chute-des-Passes on the Peribonka River in Quebec. Water will flow through a 6-mile tunnel 400 ft underground to the huge plant, at rate of 18,000 cfs. Pipes on left bring fresh, cool air in, carry stale air out

Cool Air For Air Travelers is furnished by 9 Carrier absorption refrigeration machines at the New York International Airport at Idlewild. Each machine can produce 700 tons of refrigeration. They are banked in Port's central heating-cooling plant, use high-temperature hot water for lithium bromide absorption instead of low-pressure steam as generating medium. This produced a simple design, with few moving parts. Also, auxiliary equipment was minimized ▼



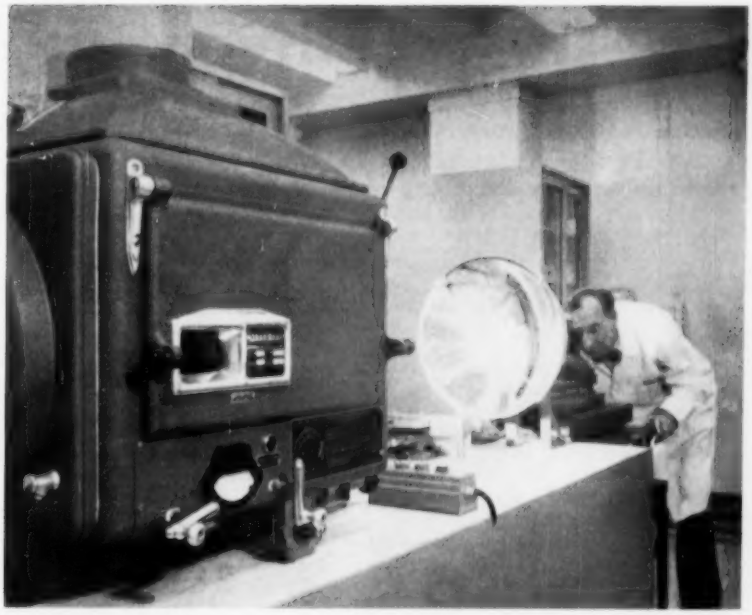


Ever Been Inside A Reactor? Here's an unusual view of the "shrouds" which will guide the control rods of neutron-absorbing material in the core of the famous Shippingport, Penna., nuclear power plant. Photo was taken inside a full-size mockup of the reactor, 45 ft high and about 10 ft in over-all diam

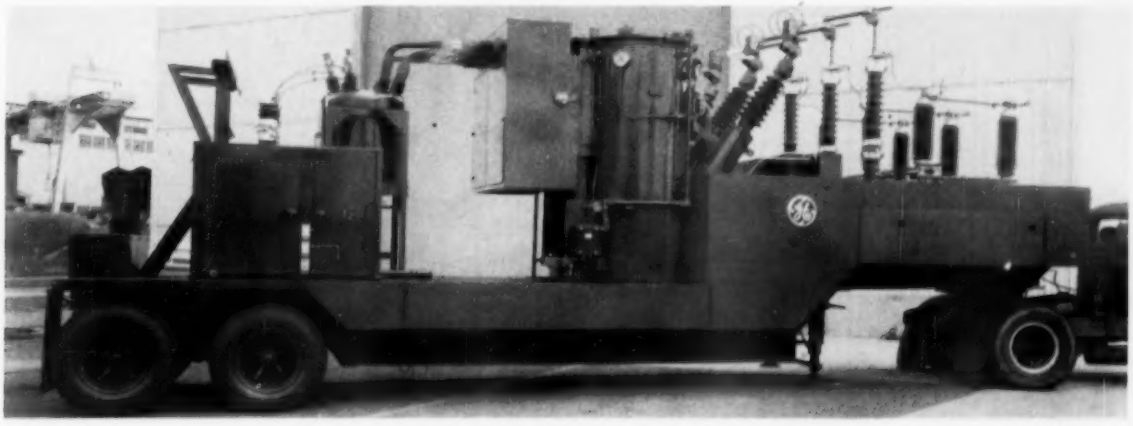
◀ **Hot Water Helpers** are these Rockwell-Nordstrom 2-way multiport valves installed on a textile plant's waste lines. They automatically differentiate between hot and cold waste, send only hot waste to mill's hot water heating systems, cut heating costs 10–20 per cent

NEWS REEL

Here's What He Sees (right): fire brick melting away seconds after it has been exposed to the high-energy beam from arc image furnace (right)

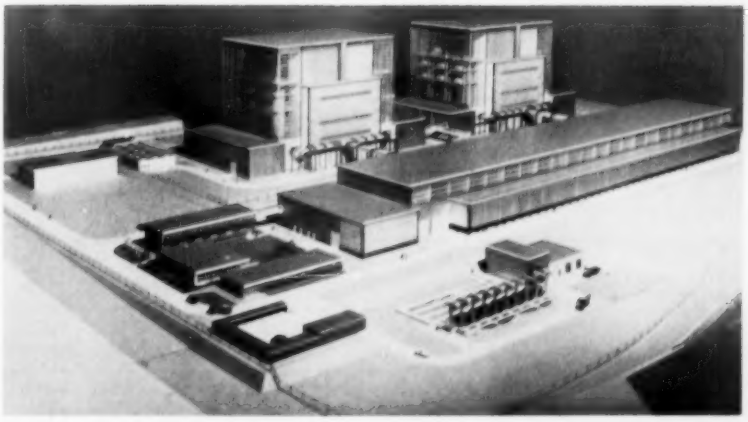


Hot As Sun's Surface are temperatures achieved with standard motion picture projection equipment by researchers at National Carbon Co. Highly polished curved mirrors concentrate rays from carbon arc into small but high-energy beam that can heat certain materials to 7000 F. High-temperature research benefits



▲

Substation Wagon, said to be largest of its kind, is this mobile unit built by GE for Puget Sound Power & Light Co. It has capacity of 9000 kva, enough electricity for city of 22,000. The mobile unit is based at Renton, Wash., stands by for emergency duty



Atomic Power Plant of Tomorrow will look like this. It's a model of the 500,000-kw nuclear power plant to be built at Hinckley Point, Somerset, England. Plant will have two gas-cooled, graphite-moderated reactors which will use natural uranium for fuel

How Do You Inventory Your Coal?

An expert discusses both old and new methods of coal inventory, and explains how accurate sampling will prevent discrepancies between an actual inventory and book values, giving better control

By FRED M. REITER

MODERN UTILITY and industrial auditing requires a precise knowledge of the tons of coal in the coal piles at inventory time each year. The *physical* content of the total inventory must check with the *book records* of the total weights of all coal received by rail, trucks, or other means of transportation throughout the year — also with the quantity consumed, and the amount determined to be on hand. These book values are the results of the daily recording of purchasing requisitions, receiving reports, operating logs, and other records. In our own company these figures became punched IBM cards, for posting to the various summary reports that came out daily, weekly or monthly.

Figure 1 illustrates our summary form, which shows the coal situation each week. Here are listed all coal receipts by various means; coal consumed; and the total inventory of coal. This is broken down into coal on hand, in bunkers and pits, on cars, and in the actual storage pile for our four stations. It also notes the change in the stockpile, whether it is building up or being depleted, as a guide to procurement and shipping conditions.

Form W-1615 7-54

To: Fuel Department
Power Production Division

Subject: Coal Situation; Cumulative Totals for the Month

COAL OPERATIONS: June 1 thru June 7

STATION 195 5	Storage Pile Inventory Tons	Total Coal Consumed Tons	Total Received			Railroad Cars	
			Coal Tons	Trucks	B.B. Cars	Unloaded	Left on Track*
F. M. TAIT							
June 1	40,659.68						
" 1 to 7		2,049.45	2,188.85	0	37	47	9
" 7	41,399.08						
Change in Storage Pile	+ 739.40	Coal in Bunkers and Pits:		2,417.13		Tons*	
		Coal in Cars: 51 Tons Each.					
O. H. HUTCHINGS							
June 1	188,565.99						
" 1 to 7		16,350.20	15,711.45	498	192	187	62
" 7	187,652.24						
Change in Storage Pile	- 913.75	Coal in Bunkers and Pits:		2,836.20		Tons*	
		Coal in Cars: 51 Tons Each.					
LONGWORTH STREET							
June 1	27,373.37						
" 1 to 7		----	----	0	0	0	0
" 7	27,373.37						
Change in Storage Pile	----	Coal in Bunkers and Pits:		795.46		Tons*	
		Coal in Cars: 51 Tons Each.					
THIRD STREET							
June 1	7,170.51						
" 1 to 7		1,130.35	1,214.80	0	19	18	1
" 7	7,184.96						
Change in Storage Pile	+ 14.45	Coal in Bunkers and Pits:		759.77		Tons*	
		Coal in Cars: 51 Tons Each.					
TOTAL							
June 1	263,769.55						
" 1 to 7		19,530.00	19,115.10	498	248	252	72
" 7	263,609.65						
Change in Storage Pile	- 159.90	Coal in Bunkers and Pits:		6,808.56		Tons*	

*Not included in storage pile inventory, but included in coal received.

Date: 6/15/55

Fred M. Reiter

Fig. 1. Sample of weekly coal summary for four plants. Note that consumption figures are weekly, while the coal pile inventory is kept current on an annual basis

All of the figures on these weekly reports are taken from the daily routine forms as mentioned above. But, once a year it is necessary to actually "weigh" the coal in the storage piles, pits, bunkers, and cars. This is a physical check of figures, compiled throughout the year, on the books.

Besides being the expansion chamber for the varying amounts of coal received and consumed daily, and serving as a the reserve fuel in case of failure of supply, the tonnage of coal in inventory has important fiscal values. Annual reports of assets, calculated price of coal burned (for purposes of rates on escalator clauses), property taxes, and other basic fuel cost data, must have these tonnages officially checked and assured by audits.

Inventories must be determined as of a given date, and hour, as established by management every year. The date need not coincide with the calendar or fiscal year, but the month selected should be at a time of maximum convenience, and minimum complications, for the civil and chemical engineers.

The closing, or cut-off, time is usually set at midnight of the end of the selected month, such as Sept. 30. At 12:00 midnight, readings are taken at all designated points of measurement, at all stations, so that as of that moment, coal quantities at all locations are obtained. Since this is the same time each year, precise annual inventories can be computed, and checked against the book figures. (The accounting system may follow the procedure outlined in POWER ENGINEERING, April 1955, which portrays the daily use of IBM coal cards.) This particular card system is almost automatic in its complete accumulation and disposition of daily coal tonnages. The accuracy of the records kept by mechanical accounting is very high. These records are the accepted standard to which other measurements are referred as the base, in per cent of deviation. Such accuracy enforces the most careful inventory procedures on the sur-

veyors and chemists, because any undue deviation might be assumed to be their errors. This will be discussed later.

Having set midnight as the exact time of the start of the new year, all pertinent measurements must be coördinated to meet this point of cut-off. Arrangements are made for the day unloading shift to have all bunkers full, coal handling belts and conveyor systems clear, pits as empty as possible, and all extraneous coal cleaned up. Then, the number of areas of measurement, and calculation, are at the bare minimum. All cars of coal are emptied, so no change in full cars on the tracks will occur until all inventory measurements are completed.

During the day before cut-off, the coal piles are finally gone over with bulldozers, so that surfaces are smooth, and sides are cleared of valleys and ridges. The piles should present as simple a geometric form as possible.

There are a number of methods used to prevent excessive erosion of the sides of the pile, and prevent furrows and ridges. Some firms use a larger size coal, 3-in., to cover the sides of the pile. These large pieces resist washing down by rain. Others spray the fine carbon-size coal, on the sloping sides, with tar or other inexpensive coatings. Over a year's time considerable coal can be washed away, unless protected in some such manner.

During inventory, no coal is added to, or taken from, the pile, so that no alteration in the content occurs during the period of measurement. If a change is necessary, or should it take more than one day to survey the pile, bulldozers can take coal from a selected corner which has either been measured, or will be surveyed the second day. This assures the inclusion or exclusion of this increment, as may be required.

Bunkers, Pits, Cars

The coal consumed from the bunkers, from the time of filling up to the midnight cut-off time, is recorded from the readings of the coal meters of the boilers. Then, the net coal contained in these bunkers at midnight can be computed as inventory coal, and added to other stocks.

This procedure has been systematized, by means of forms designed by the Auditing Department. It has become a simple matter for all operators to record their data as a normal, prescribed, procedure. The forms are signed by the Station Managers, as certifications to the Auditing Department, of official records.

Form 1 is the full coal car record; it consists of four sheets. *Sheet 1* lists the cars on hand on the last day of the month, prior to the midnight cut-off time. *Sheet 2* lists the full cars on hand on the first day *after* the cut-off. *Sheet 3* lists all full cars unloaded on the day of inventory, and *Sheet 4* lists the full cars of coal received on inventory day. In this way the *net* amount of coal on the tracks, as inventory at cut-off time, can be checked and computed.

Form 2 lists all coal in bunkers, pits, and other containers, and gives the times of measurement. On a typical set of forms, the bunkers were filled to their 900-ton capacities at 2:15 P.M. on the 30th, and at 3:00 P.M. on the 1st. Coal consumed up to midnight was determined from the station boiler scale readings, and is listed on the lower half of the form. The subtracted net inventory in the bunkers was then posted to the 12:00 midnight columns above.

Checking the Coal Pile

The methods used in surveying coal piles are familiar to most readers of POWER ENGINEERING. One or two parties of surveyors take measurements around the periphery of the piles. The number of parties used depends upon the size of the pile, the time limits, and the number of survey groups (and instruments) available at the time. Since we had four piles to survey by the same midnight cut-off, we allowed 48 hours for the complete job. Because of our own expansion program on gas and electric transmission lines and other work, our own crews were heavily occupied. We found it advantageous, particularly for auditing purposes, to utilize the services of an independent local firm of professional engineers, whose reliability was well established.

They supplied complete crews as necessary, by being alerted several months in advance; this enabled them to allot men and equipment for our dated job on the days arranged. Our station men went over the piles

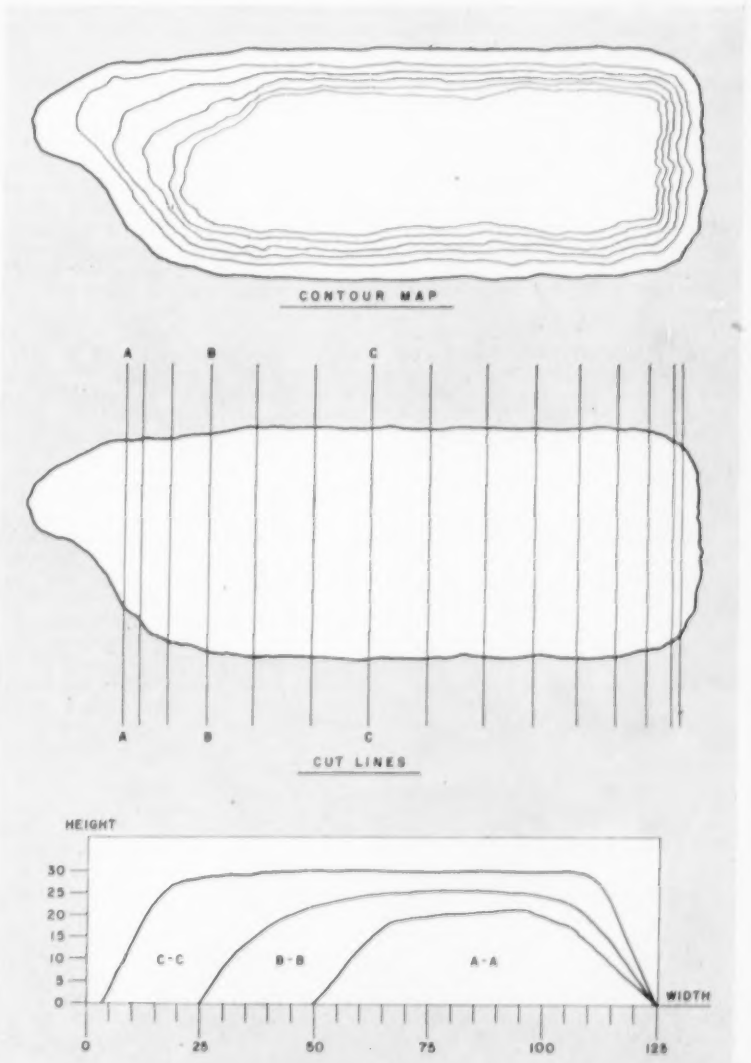


Fig. 2. Typical contour map of coal pile, sketch of cross-sectional cut lines, and sections through pile at A-A, B-B and C-C. Interval used on counter map is 1-foot

Table I. Comparison of actual average densities with 5-year weighted averages. Latter figures produce more accuracy

Table I. Comparison of *actual* annual average densities of coal with the *five-year moving* annual averages. Latter were used in determining the weights of coal piles at four power stations.

Station	Pounds of coal per cu ft			
	A*	B	C	D
Year	Average of all samples taken at each station, as taken			
1951	63.92	69.45	66.28	67.23
1952	58.63	69.80	65.46	67.72
1953	60.50	66.76	65.64	67.71
1954	60.76	69.57	69.32	68.02
1955	60.85	66.29	70.88	70.02
1956	61.09	67.50	64.13	69.31
	Five year averages actually used			
1951	—five year average not used—			
1952	61.74	68.74	66.15	68.04
1953	60.96	68.55	65.82	67.76
1954	60.96	69.02	66.58	67.88
1955	60.93	68.37	67.52	68.14
1956	60.37	67.98	67.09	68.56

* Coal pile of Station A not compacted.

Table II. Table showing final inventory figures, and adjustments required. Other pertinent information is listed also

Table II. Final inventory figures—comparing measured quantities with book values.

Item	Station A	B	C	D	Total
1. Measured volume of pile, (1000 cu ft)	221.6	749.9	959.0	4,996.0	—
2. Sp. Wt or density, (lb per cu ft)	60.93	68.37	67.52	68.14	—
3. Physical pile only (tons)	6,752	25,634	32,377	170,214	234,977
4. Total physical inventory, (tons) *	7,656	26,849	35,382	174,892	244,699
5. Book inventory, (tons)	7,815	27,301	35,722	180,705	251,543
6. Difference, 5—4 (tons)	—159	—452	—340	—5813	—6764
6A. Per cent of 4	—2.03	—1.66	—0.92	—3.23	—2.69
7. Per cent of coal used during year	0.33	0.63	0.22	0.69	0.60

* Includes bunkers, pits, cars, all coal including piles.

with their chief surveyor, several days before the date of survey. Thus, we could render our greatest assistance in smoothing portions of the piles, and in setting up schedules that would best conform with coal and load conditions. This advance inspection has improved the ease of operation, and the final accuracy of the physical inventory.

The surveyors produce a contour map of the pile at approximately 1-ft elevations. This horizontal contour map is broken into vertical elevation sections, whose width varies with the slope and complexity of the shape of the pile. Where the pile is flat and uniform in dimensions, sections are wider. They become very thin where the volume changes are rapid. These vertical sections are laid out in a series of graphs carefully drawn to scale, and to conform to the original levels and undulations of the ground on which the coal lays. Our oldest station has several inherited pits, or depressions, under its coal pile, whose volumes are known; their coal content is added to the volumes measured above ground.

These trapezoidal slices are planimetered and their areas computed. The volume of each slice becomes the average area of its two sides multiplied by its thickness. The sum of all the slices becomes the volume of the entire pile.

Surveyors similarly measure and compute the volumes of all pits, compartments, and other ground containers of coal, at each station, from measurements taken when the crews were at the station. Known bench marks, established on the first survey, are used throughout all readings. These basic records make the surveys short, routine jobs, of considerable accuracy. The professional survey firm submits its certified reports in terms of cu-ft volume of coal at each station. This certification takes about two weeks after the measurement dates.

Figure 2 illustrates a sample contour plot of a coal pile, showing the plan view contour lines. It also shows the lines of elevation cuts through the pile, whose faces are used for cross-sectioning of the areas. Some representative faces are presented, solely to illustrate the graphic work and computations of the engineers. It should be noted that the elevation cuts are closely spaced where the contours change sharply. These quick rises require greater precision than where spaces are wider, and the areas straight-away. It is desirable to have clean truncated pyramids to work with, if possible.

Determination of Coal Density

While the *volume* measurements are in progress, the chemists dig down into the coal for samples. The volume of the coal pile is supplied by the surveyors in terms of cu ft of coal. These must be converted into *short tons*, the standard unit of buying, shipping and burning coal. Since coal is priced on a 2000-lb ton basis, and fiscal inventory values must appear in dollars, it is necessary to convert from cubic feet to pounds, to tons, to dollars.

Determination of the *density* of a coal pile, of about 200,000 tons of considerable height, is a critical operation for the chemical department. Its accuracy can be the subject of much discussion among accountants and auditors. The density is affected by many factors: weather, compactness, variation in coal sizes and sources, and by the diligence of the chemists in obtaining truly representative samples. Little question is raised as to the accuracy of the laboratory work. The method of sampling, and number of increments, are vital. Even slight variations in the findings from a one-ton sample of coal, from a pile of 200,000 tons, are magnified greatly.

The method of sampling coal piles has been constantly under scrutiny. Originally, a steel box was pounded into the coal pile for its one cu ft of coal to be weighed. Later methods have been developed for removing several hundred lb of coal sample, from holes dug 6 to 10 ft below the top surface of the pile. Placing a soft plastic sheet into the cleaned hole permits filling this hole with water. (The depressed level for the test hole may be accomplished with a bulldozer.) After the bulldozer has cut down to each test level, the coal is shoveled out of its hole by hand, and the walls carefully picked and cleaned.

The coal removed is collected on a flat wood platform, lying on the surface of the coal. This board has a hole that conforms to the hand-dug, or augur-bored, hole in the coal. When the plastic "sock," or sheet, is inserted in the hole, it is filled to the surface level of the original coal with a weighed amount of water. The temperature of the water is taken into account, for the purpose of using the precise density of the water as the base of calculations.

The specific weight of the coal, in lb per cu ft, is then calculated as follows:

$$\text{Sp. Wt. of coal (lb per cu ft)} = \frac{\text{Weight of coal removed}}{\text{Weight of water to fill}} \times \text{density of water (corrected to temperature). (lb per cu ft)}$$

Since the *volume* of water is identical with the *volume* of coal, the volume of coal removed is unimportant. The sample should be large enough to give reasonable accuracy.

It is important to get enough samples distributed throughout the pile, to be thoroughly representative of it. Fifteen samples are taken, on a station pile of about 200,000 tons. Another station had a coal pile that

was not completely compacted. Nine samples were taken on the slopes and other points, as well as on the top of this pile.

Variations require thorough averaging among lots of increments. In fact, for almost the past 10 years a moving 5-year average has been used; adding the latest, and dropping the fifth year back every year. Using the five-year average multiplies the number of increments five-fold. This can be done because best stockpiling practice favors retaining the original coal intact without any turnover, especially when compacted. This keeps the oxygen infiltration at a minimum, and reduces continued weathering and fire hazards. Since about 90 per cent of the pile remains fixed year after year, the number of increments is greater, and the final specific weight will be more representative. Results have so indicated. Table 1 shows a group of five-year averages used each year for the past 6 years.

The weight of the coal pile then becomes the product of the surveyed volumes (in cu ft), and the specific weight in terms of lb per cu ft. Table 2 summarizes these computations for 4 stations. Line 3 gives the final weight of the pile of coal.

However, to these pile weights must be added the coal in the bunkers, cars, trucks, pits and other compartments, and recorded on Form 2, listed in line 4. This gives the total physical inventory, of all coal on the premises, as of midnight of the 30th. The book inventory, line 5, gives the same figures, derived from the daily records. The differences, in tons, and percentage of the book inventory (line 6), are well within normal tolerance of power stations.

The gross tonnage of coal burned during the year is greatly in excess of storage, so the inventory discrepancy (in terms of the coal that moved through the yards), drops to fractions of a per cent. The normal stockpiles of utility plants run somewhat in excess of 100 days, so this percentage would be about 100/365 of the percentage of line 6.

Mention might be made of the use of moisture determinations shown in the tabulations of the station stockpile sampling. While our chemical department made the analyses of moisture for all samples, no corrections were made. Using the dry season of the year, when sudden heavy rains seldom occur, and five-year averages, the use of moisture corrections would add nothing but complications and doubts. Samples taken at depths of 6 to 10 ft, especially with compacted fine coal, are little affected by scattered rains, as the tabulation indicates. Where larger sizes of coal are stored, without heavy compacting, heavy rains could inject some errors in the application of the density calculations to the full pile.

For such cases, adjustment can be made that will bring the final physical inventory in truer relation to the scale weights of the coal as received. While coal might have been exposed to adverse weather in transit from the mines, there is more danger of moisture pickup in the storage piles than on the trip. This is a controversial point.

The moisture in samples taken at four stations were plotted against weighed densities, to see if any relationship could be established between them, that would justify a correction for moisture.

It is *not* believed that adjustments for moisture in coal piles will be helpful. THE END

Use a Steam Jet Syphon for Versatility, Economy

YOU CAN perform a great variety of services with steam jet syphon units, and often with considerable savings over other methods. Imaginative power engineers at Gillette Safety Razor, Boston, effectively illustrate this by using such a unit for the annual removal of water and sludge from a penstock, and for the clearing of snow from the company parking lot.

Prior to the use of this system, accumulated silt was removed from the penstock by contractors every two or three years. Although annual removal was considered desirable, the cost of the job made this prohibitive. Now the cost of annual removal, including steam and labor, is around $120, a fraction of the contract price. The cost of the entire installation was about $500.

Snow handling costs are now about 10 per cent of what they were when snow handling equipment was used, and the job is done faster and more efficiently.

As shown in Fig. 1, the syphon is permanently located in a horizontal position close to the bottom of the penstock, with the appropriate piping and valves as indicated. When the penstock is cleaned, the discharge-to-bay line is opened, and the steam, issuing through the syphon nozzle, entrains silt and water from the penstock and discharges against a head into the bay nearby. When snow is to be removed, as much as 500 ft of 3-in. fire hose with a fire nozzle is attached to the by-pass discharge line. Using steam at 175 psig and entrained salt water from the penstock, hot water is discharged which melts the snow and washes it into the catch basins.

The syphon is a versatile tool which, when used with imagination and ingenuity, can perform well any number of unusual functions in addition to its normal uses.

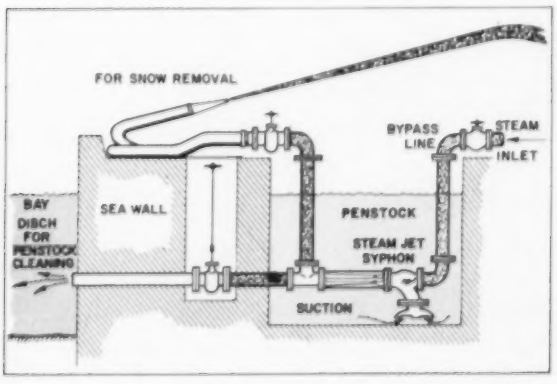


Fig. 1. Diagram showing dual purpose steam jet syphon

Photo Courtesy of Schutte and Koerting Co.

Fig. 2. Snow removal costs 1/10 of conventional methods

Versatile Cable Trough

This Picture Series Shows

Fig. 1. Neat, orderly appearance of cable trough facilitates housekeeping. Note lights suspended from cable trough

SINCE CABLE TROUGH, or open wire raceway, has been so universally accepted, we feel that power engineers might enjoy a pictorial review of its many general applications. The series of photos on these two pages show on-the-job installations in two power stations; one is the Ashtabula plant of The Cleveland Electric Illuminating Co; the other is Toledo Edison's Bay Shore Station.

Only a few years ago, practically all power wiring was either wire in conduit, or busway of some type. Then, as cable trough became better known to industry, its lower cost and versatility caused its wide acceptance in the power field. Practically every power installation is a candidate for at least some cable trough, even though some of the wiring must be put in conduit or raceway, for mechanical or other reasons. As the trough came into wider usage, power engineers discovered so many unusual installations that manufacturers were kept busy developing new accessories with which to meet the engineers' demands. To date, the trough makers have done an extremely good job, as evidenced by these photographs.

Material Has Wide Application

Cable trough usage is not limited to heavy cable use; in fact some of its greatest application is in the communications field. Electronics laboratories, broadcasting stations, and telephone installations are ideal applications for the product. In any wiring installation where frequent changes in circuitry is expected, cable trough is highly desirable, due to the ease of removing and replacing wires and cables.

Electronics manufacturers' shops requiring test and signal circuits at each work bench, will find cable trough the ideal raceway for distribution of cables. Drop-out bushings can be installed at each bench, so cables can be fed down to the work position.

Installations of pneumatic instrumentation, involving many lines of copper tubing, can be facilitated with the use of cable trough; much time and labor is saved by grouping the lines of tubing, rather than individually attaching them to a surface.

Solid trough system is used where a complete protection of the cables from dirt, mechanical injury, and corrosive elements is required. However, the expanded, or punched, metal trough is most generally used, and is, of course, the cheaper installation. Insofar as future expansion is concerned, cable trough can be expanded at a minimum of cost.

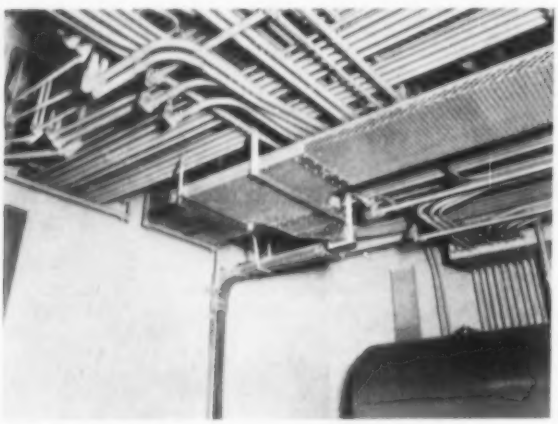


Fig. 2. Dramatic comparison between maze of conduits and cable trough. Note horizontal and vertical tap-off on wall. Pull-boxes and conduit pull fittings are eliminated, and cable removal or replacement is easy in cable trough

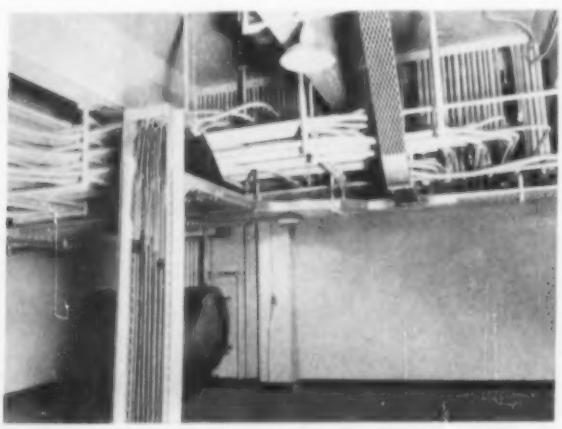


Fig. 3. Here as many as 39 cables are supported vertically by eye bolts, which attach to cable grips. Two lengths of cable trough are bolted back-to-back, to accommodate the cable bulk; cables then distributed horizontally to the terminals

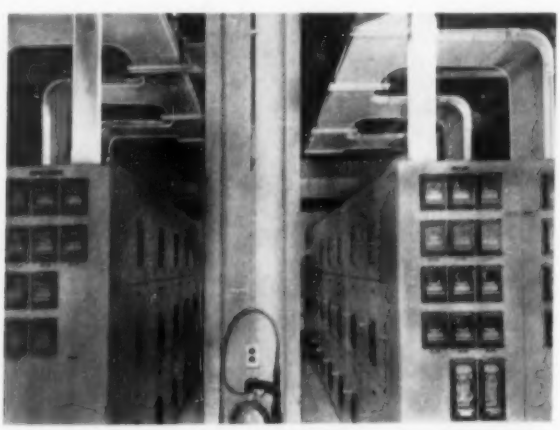


Fig. 4. Solid trough and covers here distributed 480 volt feeders from switchgear. As in the open-type, a complete line of ells, tees, reducers, drop-outs, and other adapters are furnished by the manufacturers, to complete the job

Has Many Applications

How Engineers Are Using It

Modern construction presents many problems for the design engineer, in that the number and complexity of mechanical services has increased over the years. It is not uncommon to see air ducts, sprinklers, unit heaters, cooling units, piping, water and drain lines, and other facilities — all from a common ceiling. The job of designing all these is a complicated one; the coördination of the various utilities is even a more difficult task. Many a project has been delayed, or even stopped, simply because there was a conflict between two building trades, both of which tried to take priority on a given hanger area. Because of its limitations, sheet metal ductwork necessarily takes precedence over more flexible facilities. Sprinkler systems run a close second, or even first, in many cases. Therefore, the more flexibility an electrical system has, the easier it is to work out a satisfactory solution to conflicts. For example, if a number of cables must be run on a ceiling where air ducts cross the path, cable trough can be installed up to the edge of the duct; then, the cables can drop down, and under the duct, and be continued on the other side. A short piece of trough can be hung under the duct if desired for appearance.

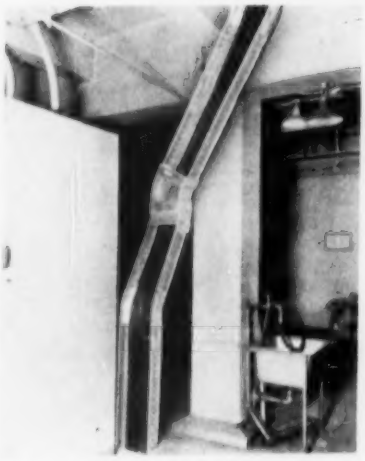


Fig. 8. Self-supporting riser, of two troughs mounted back-to-back, is offset in two planes, by using 30 deg fittings

Electric and Economic Advantages

Current-carrying ratings of cables in open cable trough are considerably higher than cables in conduit, due to the dissipation of heat. Cost of pulling cables is reduced, because practically no friction resistance is encountered when laying the cables into the troughs; also, the measurement of cable lengths is greatly simplified.

Cable trough can be run indoors or outside, if it is protected against rusting, and the cables are of a weatherproof type. Proper application of open or closed trough, and correct selection of cable, will give code compliance on any commonly used operating voltage.

A comparison of cost between a complicated cable run-in conduits and in cable trough — quickly shows the economic advantage of the latter. The greatest savings will prevail in those cases where a large number of conduits is indicated, of course. Further, where space is critical, and a large number of cables are being installed, it is often impractical — or impossible — to work in the required conduits. Or, if the conduits can be squeezed into the allotted space, the labor cost of installation is exorbitant. This is the case where cable trough shows the greatest savings; further, the time of installation is cut approximately two-thirds. Photographs on these two pages were furnished by T. J. Cope, Inc., Philadelphia, manufacturer of trough and fittings.

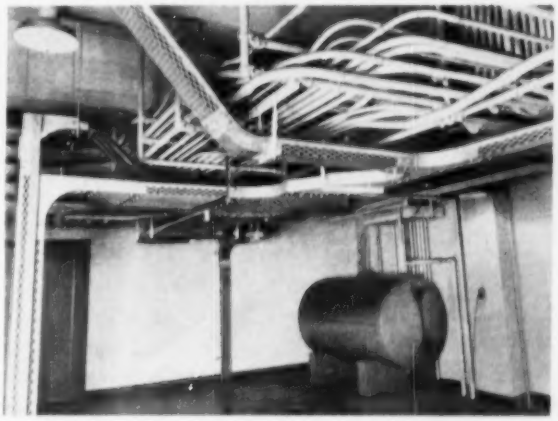


Fig. 7. Another view of the installation shown in Fig. 3. This shows the back-to-back trough in the vertical run; also the simplicity of terminating a vertical run of cables, then distributing them horizontally to their terminal locations

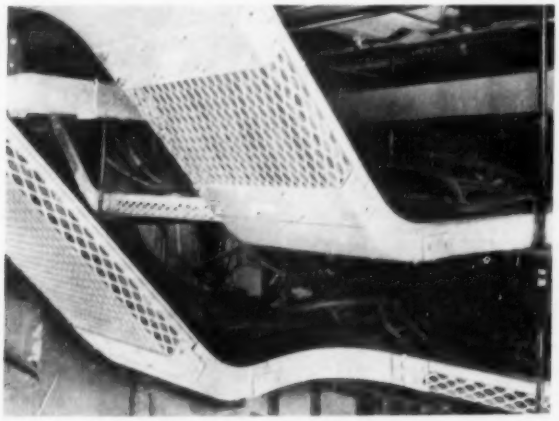


Fig. 5. Close-up of cable trough installation, showing change of plane and direction. Note that dozens of cable are laying in each trough, without being laced or mechanically held into any particular arrangement or sequence of wiring

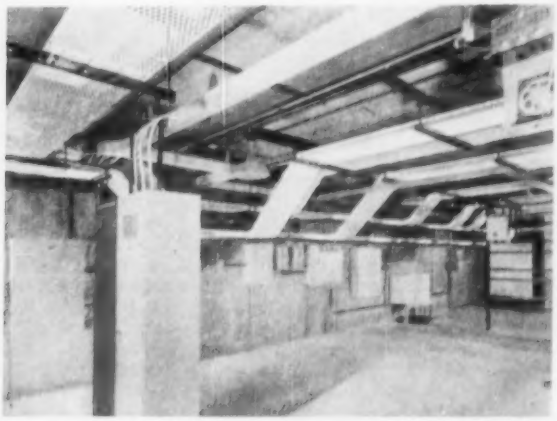


Fig. 6. Here is a good example of a control cable installation. Cable trough receives cables from banks of conduit on wall in background. Note horizontal tap-offs for future runs of cable trough, on lower run of trough, for end of room

Fig. 1. A general view of Blandin Paper Co mill, on the Mississippi River at Grand Rapids, Minn

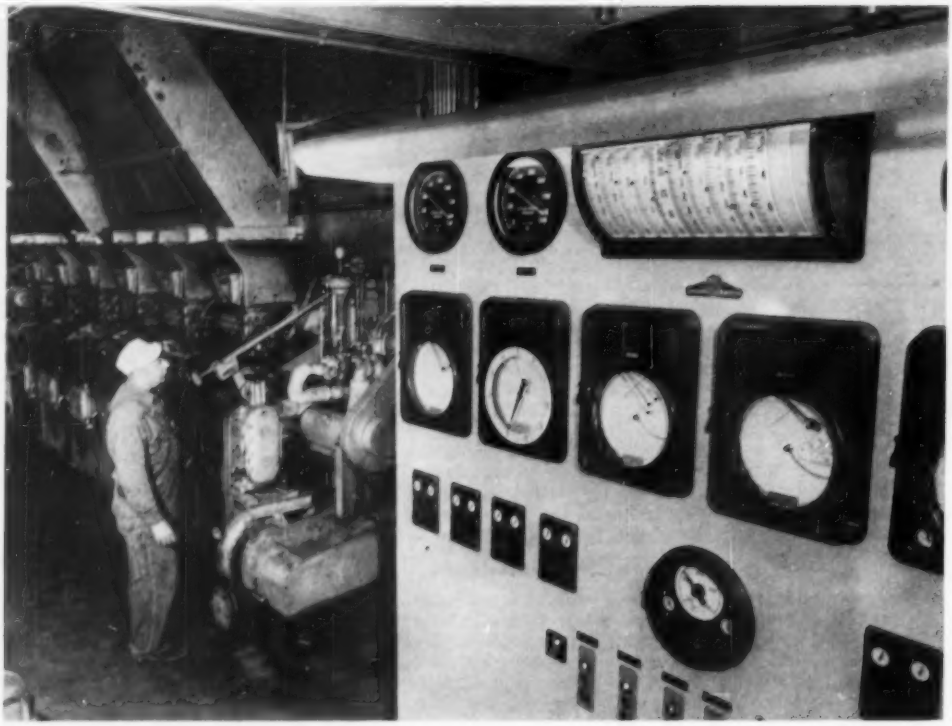


Fig. 2. New 175,000 lb-per-hr spreader-stoker-fired boiler and its controls in Blandin plant

New Boiler Gives Blandin Paper Operating Flexibility

Former power plant, without spare capacity, just barely managed to carry Blandin Paper Co load. By adding new boiler, they cut fuel costs, provided new freedom in operation, maintenance, production

UNTIL 1945, Blandin Paper Co, Grand Rapids, Minnesota, manufactured newsprint. But at that time it converted its processes to produce magazine paper, which has since been used by the publishers of several of the country's leading general circulation magazines.

In order to produce this magazine paper, the paper machines were modernized and speeded up, modern ground wood equipment was installed and the entire paper plant brought up to date.

For various reasons, no additional capacity was added in the power plant. Power equipment consisted of steam turbine generators and pulverized-coal-fired boilers, together with two hydroelectric plants. As paper production increased, the power equipment was pushed to its limit. There was no spare capacity.

The boilers were pushed so hard that the plant had to burn premium coals in order to carry the load. Furthermore, it was very difficult to maintain the equipment, for that maintenance had to be scheduled for periods when paper production equipment could be shut down.

However, the power plant has been enlarged since 1951, until it appears as shown in the attached illustrations. Addition of the new boiler late in 1954 has produced a most welcome and satisfactory change in the operation of the entire paper mill.

Flexibility Increased

The boiler, shown in Figs. 2 and 5, is of conventional design but the added capacity has permitted taking the older units down for much needed work. The new fuel burning equipment can burn a wide variety of reasonable-cost coals, while the price of the premium coals previously required has spiraled upward.

Now the entire power plant maintenance program can be scheduled. Yearly shutdowns for maintenance are scheduled for various equipment at planned intervals. The paper mill runs seven days a week but is shut down for one Saturday and Sunday every month.

Regular power plant maintenance is done by the boiler and turbine room staff. On any big maintenance job, the general maintenance staff of the mill can supply certified welders, machinists, millwrights, and all necessary tradesmen and skilled mechanics. Figure 7 shows the maintenance order form used, made in triplicate.

In short, installation of the new boiler has given the paper mill the necessary freedom for economical power supply.

Boiler Installation

The boiler of Fig. 5 was installed in the space made available by removal of an old boiler plus some space gained by extending the boiler room 16 ft in length. In doing this, an interesting construction detail arose. It was found that the bottom of the existing coal bunkers came below the hoppers of the new stoker hoppers. So screw conveyors were installed slanting upward from the bunker bottoms and feeding coal scales discharging to the stoker hoppers.

Present arrangement of the power

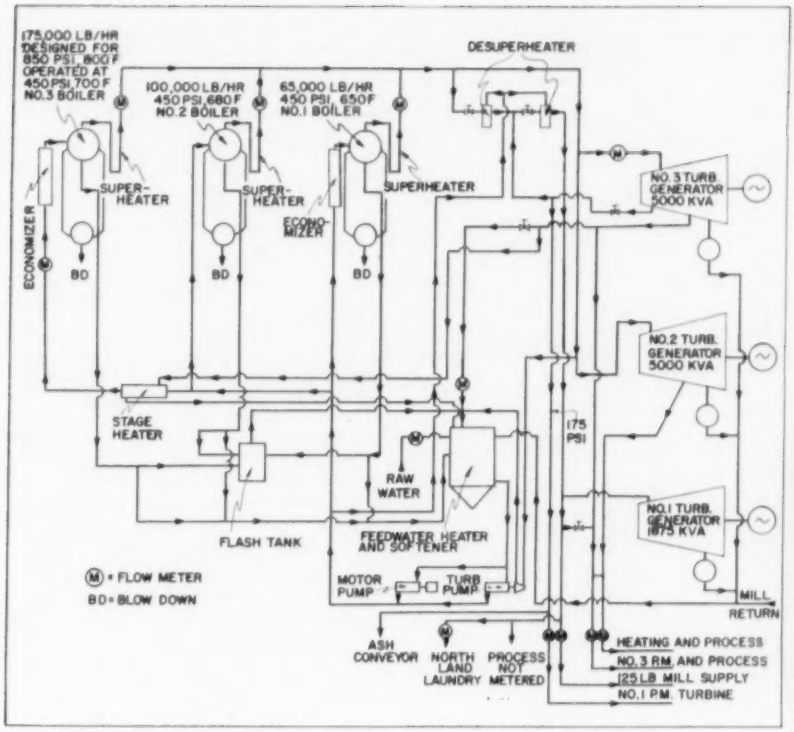
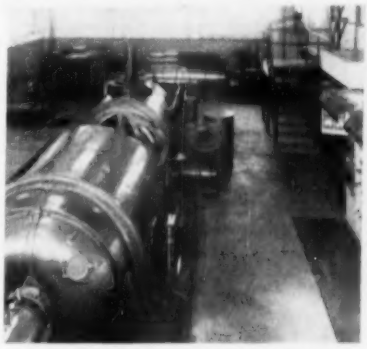


Fig. 3. (Left) Flow diagram of complete steam power plant of Blandin Paper Co; 3 steam generators and turbines supply power and extraction steam to the mill

Fig. 4. (Below) An over-all view of the turbine room at the Blandin Paper Co's mill, showing two of the three Allis-Chalmers steam turbine-generator units



plant, with the flows of steam and water to process, is shown in Fig. 3.

There are now three boilers: No. 1, a Foster Wheeler boiler, designed for 65,000 lb of steam per hour at 450 psi, 650 F; No. 2, a B&W integral furnace boiler designed for 100,000 lb per hr at 450 psi, 680 F; and No. 3, the new boiler, designed for a maximum capacity of 195,000 lb per hr, 850 psi, 800 F, but operated at present at 175,000 lb per hr, 450 psi, 700 F.

These boilers furnish steam for the three Allis-Chalmers turbine generators shown in Fig. 3, one of 1875 kva and two of 5000 kva each, all generating at 2400 v. The connections of the extraction steam pressure systems are shown in Fig. 3.

Future operating conditions for the new boiler will be realized with the installation of a 10,000-kw double-extraction turbine generator at some indefinite future time.

One stage of feedwater heating is now employed with a second stage to be added when the future conditions are to be met. Some changes in the superheater surface will be required when the higher pressure and temperature are used.

The stoker of the new boiler is a Detroit Rotograte spreader stoker 21 ft 1½ in. wide by 17 ft 8 in. long. Fly ash from the boiler hoppers and economizer is returned to the furnace. Fly ash at the dust collector ahead of the ID fan is rejected.

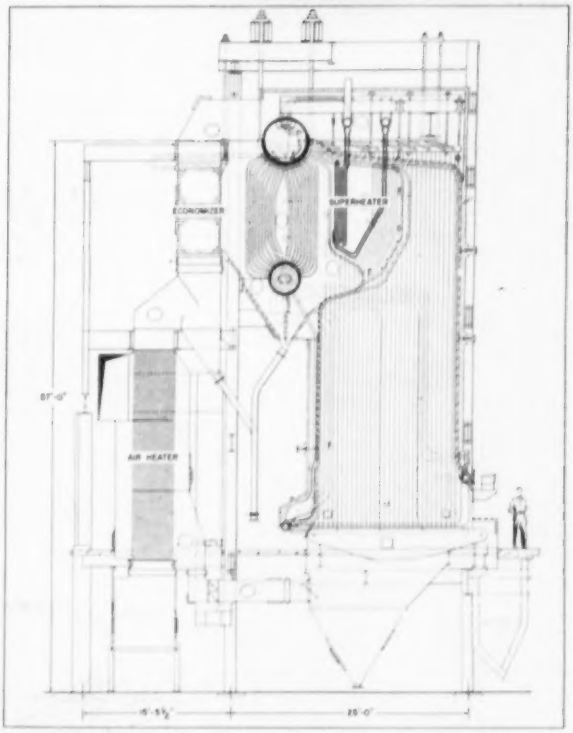


Fig. 5. (Right) A cross-section view of new No. 3 boiler with its equipment

Boiler Auxiliaries

Buffalo forced and induced draft fans are installed on the new boiler. The ID fan is driven through an Electric Machinery magnetic variable-speed coupling by a Westinghouse 350-hp motor. The FD fan, driven by a Westinghouse 150-hp motor, has inlet vane control. Bailey combustion control and three-element feedwater control are installed. Pressure piping is by Power Service Corp, with 85 per cent magnesia piping insulation by Smith-Sharpe. The unit is equipped with Foster safety valves, Edward stop valves and blow-off valves, and other valves by Lunkenheimer. Dust collector is by Western Precipitation Corp, stack and breeching by Moore-

Fig. 6. In the Blandin hydroelectric plant on the Mississippi River these two generating units deliver 2750 kva

head Machinery & Boiler Co, coal scales by Richardson. Griscom-Russell supplied the stage heater.

Engineering for the new boiler was done by Helmick and Lutz, engineers. General construction, foundations, building changes and the like were by Blandin's own construction crew. Boiler erection was by The Babcock & Wilcox Co, pressure piping erection by Power Service Corp, and insulation work by Smith-Sharpe Co.

Hydroelectric Power

In addition to the steam and power supply from the above power plant, the company obtains electricity from two hydroelectric installations. One of these is right in the Blandin plant itself, which stands on the bank of the Mississippi River. Here, as shown in Fig. 6, is an installation of two units. One of these is an Allis-Chalmers 1875-kva fixed-blade propeller type unit, operating at 150 rpm at 20 ft head and generating at 2400 v. A feature of this unit is that it has inside gate rigging, designed for ordinary open flume setting. This required special provision for lubrication of main bearings by water, supplemented by grease or emulsifying oil. The other unit in this plant is an 875-kva Leffel turbine. Both generators on the hydro units are by Electric Machinery,

Blandin's second hydroelectric plant is on the Prairie River, about six miles away. It contains one 450-kva and one 675-kva generating unit.

Finally, the Blandin electrical system has a 3750-kva tie with Minnesota Power & Light Co.

Thus the total capacity of the Blandin power system is 15,750 kva of self-generated electric power; 3750 kva purchased when required; and 345,000 lb per hr of steam.

Blandin Paper Co's entire mechanical system, including the power system, is under the direction of George W. Goelz, chief engineer, also a vice-president of the company. E. C. Ellingson is chief power plant engineer. In close coöperation with the consulting engineers and the equipment

BLANDIN PAPER COMPANY

MAINTENANCE WORK REQUISITION

Fig. 7. This maintenance order form, filled out in triplicate, is used by Blandin engineering, maintenance crew

manufacturers, they carried out the installation of the new boiler to the satisfactory conclusion related above.

As stated at the beginning, the new boiler cuts fuel costs and provides new freedom for the power plant with improvement in paper production. THE END

Electric Motors Gradually Supplanting Steam in Petroleum Refineries

GENERAL TREND for answering power requirements in the petroleum refining industry is toward the use of an increasing proportion of electric motors as compared to steam turbines. So the recent AIEE Conference of the Petroleum Industry was told by two speakers.

Lee B. Eddy, of the Universal Oil Products Co pointed out that the power requirements of oil refining processes have increased significantly in recent years. He said that the electric motor and steam turbine, which closely compete with each other for the task of driving pumps, compressors, and other rotating machines in the world's refineries, are the two most popular types of drives.

In many applications, he said, the output characteristics of these drivers are equally suited to the connected machine and selection becomes a problem of economics and reliability. He reached the following general conclusions:

1. In locations where the electric power supply is subject to frequent and lengthy outages, electric motors should not be used on any critical drives except where spared by an adequately supplied steam turbine or other prime mover.

2. Where electric power supply is dependable and of reasonable cost:

a. Sufficient non-condensing turbines (preferably of the larger hp ratings) should be installed to provide all the low-pressure steam requirements. These should include the drivers for any service requiring a variable-speed input, or where a momentary driver failure would result in an extended plant shutdown for maintenance or clean-out.

b. All other small drivers should be electric motors.

c. Large drivers, which may be either motors or condensing turbines, should be selected on the basis of a detailed economic study considering first cost, operating cost, and payout time.

Another paper at the conference reported that economic circumstances have dictated a swing back to increased use of public utility electric power in current expansion of the huge Richmond, Calif., refinery of the Standard Oil Co of California. J. M. Lindquist, company engineer, and John F. Peterson of Bechtel Corp, in a technical paper, Development of a 75-mva Refinery Power System Involving Local Generation and Utility Supply, said:

"The electrical system represents an evolution from a 110-v lighting load in 1900 to the supply of 4000-hp 12-kv motors in 1957. The system components result from an initial 34 years of growth to about 10,000 kva based on utility power, of a swing toward complete generation in 1936, incremental generation in 1948, and now a swing back toward utility power as dictated by economic circumstances."

Very heavy expansion of the refinery plant is planned, with the 1956 load of 49 mva growing to almost 80 mva within the next four years.

United Saves by Burning Marginal Fuels

By burning a mixture of coal-tar waste and fuel-oil tank sludge, United Chemical and Organic Products Corp boiler plant realizes considerable savings at minimum of additional expense and trouble

By EDWARD J. MILLER *

WHEN ANY FUEL can be delivered for approximately half the cost per million Btu of No. 6 fuel oil, it is worth consideration, even if it does require some adjustments and extra handling in unloading, storage and burning procedures. It has proved practical and economical this summer to burn some 50 carloads of an interesting substance known as Fuel Oil Sludge and Tar Compound.

Original material was a tar-like waste from a petro-chemical plant, but when a major oil company acquired the property several years ago, a large amount of tank sludge was dumped on top of it. The resulting mixture has these typical specifications:

Ash Content	2.74 per cent by weight
Specific Gravity	1.0661
Weight per gal.	8.8788 lb
Degrees API	1.2
Btu per lb	9737
Btu per gal	86,450
Sulfur	2.97 per cent by weight
Water by distillation	26.3 "
Sediment by extraction	13.3 "

This is the latest in a long series of waste products which we have burned in the four boilers of our Calumet City plant, producing steam for process and a small amount of electric generation. It has a rather unusual source, being waste material which accumulated over a number of years in a large hole on Chicago's southwest side.

This area, called Lake Trinidad by its owners, covers approximately one acre, and varies from 7 to 18 ft in depth. Since the material is in solid form at normal temperatures, a special device had to be developed to "mine" it. This consists of two parallel horizontal drums which float on the surface, supporting between them a vertical drum which penetrates the sludge about eight ft. (For the sake of clarity, the material will be referred to as "sludge" in the balance of this article, which it is called, among other things, by the people who handle it.)

Vertical drum is well-slotted on the sides with holes ½ in. by 1 in. A steam line spirals around the inside from top to bottom. As heat from the steam penetrates the compound around the cylinder, it melts and flows through the slots into the vessel, from where it is pumped into tank cars.

For practical reasons, this operation is seasonal, this year starting in early May, and expected to terminate in November.

When the tank car arrives at its destination, about 24 hours are required to thaw it sufficiently to begin pumping. Steam is used for this purpose, the cars being equipped with the necessary coils. Six to eight hours are required to unload the car. This compares to two to three hours for the unloading of No. 6 fuel oil.

A flow diagram of the basic fuel system of the plant is shown in Fig. 1. In normal operation, sludge is pumped from the tank car directly into the 20,000-gal. blending tank, where it is mixed half-and-half with No. 6 fuel oil, and kept heated to a temperature of just under 220 F. Note that suction may also be taken from an unloading station for tank trucks.

From the blending tank the fuel is pumped through jacketed lines to the burners, where it is burned at 220 F, which has been found to give best results. A peculiarity of the fuel is that at elevated temperatures it separates, precipitating a sediment which contains a very high percentage of carbon. Care is taken to avoid this eventuality by maintaining a rather rigid maximum temperature of 220 F.

Greatest possible blending without elaborate equipment is attained in the blending tank by a system of constant circulation with suction taken from the bottom of the tank. Reintroduction is then made through a diagonal pipe near the bottom, which keeps the fluid in circular motion throughout the entire tank. This is in addition to the natural flow of the hot materials rising from the heating coils.

Similar system is used with the 40,000-gal. outside storage tank, where No. 6 fuel oil is kept at 125 F. It is to this tank that the fuel oil is pumped directly from the tank car, and stored for use in the blending tank.

The present system of operation is the result of a considerable period of experimentation and trial and error. Following the expiration of a source of petroleum pitch † which we had burned successfully for several years, we investigated a number of substances which offered various inducements, and elected to give this material a serious trial. It was initially felt that it would be necessary to blend the sludge with a plasticizer, and this was done by the supplier.

In 1955, nearly 250,000 gal. of sludge were burned, and in 1956, this figure went up to 326,000. 82,000

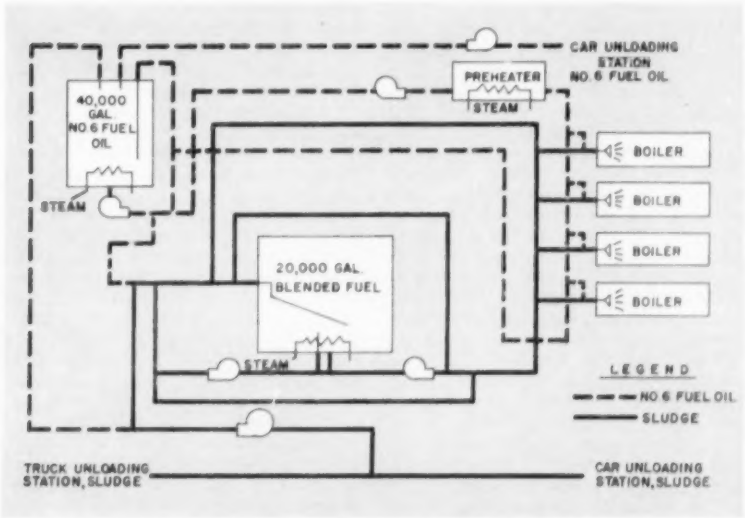


Fig. 1. Flow diagram for dual-fuel system at United Chemical boiler plant. Note flexibility which is designed into system, also constant circulation arrangement

* Chief Engineer, United Chemical and Organic Products Corp. Div of Wilson & Co at time of writing, now Assistant Maintenance Engineer, Continental Illinois Bank Building, Chicago

† See, Petroleum Pitch . . . An Excellent Boiler Fuel, by Mr. Miller, POWER ENGINEERING, June, 1953

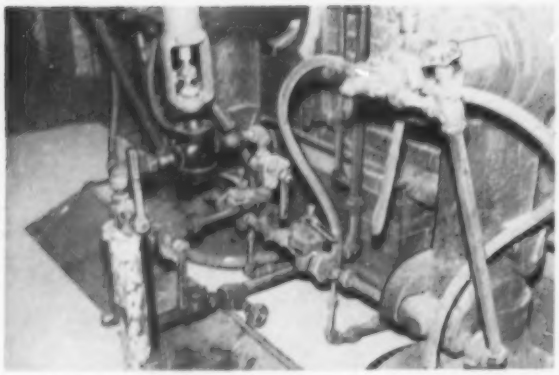


Fig. 3. Dual-fuel piping arrangement at burners. Sludge rises from floor, oil comes from preheaters above. Note check

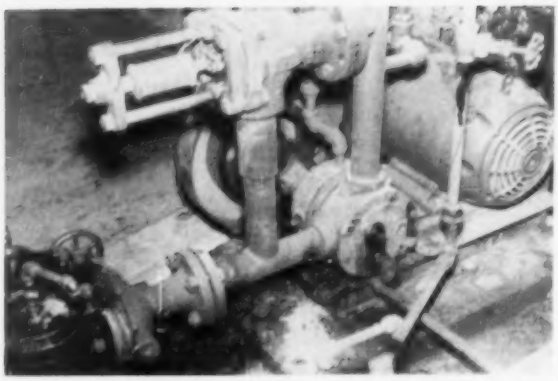


Fig. 2. This is constant-circulation pump under outside fuel oil storage tank. Can be used to pump directly to the boilers

gal. of plasticizer were mixed during these periods. From the original mixture of one-to-one, the amount of plasticizer was gradually cut down until it was found that as little as one part plasticizer to nine of sludge could be used, and at this ratio, the season of 1956 was finished without incident.

During the winter of 1956–57, No. 6 fuel oil was burned, and in the spring it was decided to try mixing the sludge with this, making a continuous operation with as little effort to change over as possible. This was done, and was found to be successful.

With the fifty-fifty mixture, fuel costs per 1000 lb of steam decreased more than ten per cent from the cost for straight No. 6. It is felt that this decrease justifies the expenditure of considerable effort on our part to burn this waste material.

Operating experience has shown that tubes may be kept clean with the usual number of soot-blowing operations, one per shift. The refractory material of the furnace becomes coated with a high-gloss, ceramic-like glaze. No attempt is made to remove this, for as the thickness becomes excessive, it melts and runs down. This is not expected to be a source of any trouble whatsoever.

During the periodic overhauls of the boilers, it is necessary to remove from the bottom of the furnaces monolithic glazed clinkers. This is done with jack-hammers. The small amount of extra labor required here has not proved to be a problem, nor has it necessitated more frequent outages than those usually scheduled for internal inspections, which is every three months.

Every effort has been made to keep this a very versatile plant, capable of coping with most eventualities without interruption of service. Note the flexibility provided in the principal routes of flow in the flow diagram. While details such as valves, check valves, etc. are not shown, it is apparent, for instance, that the circulating pump on the outside tank can actually be used to pump fuel oil directly to any of the four boilers.

On the average the boilers furnish 50,000 lb of steam per hour at 165 psig, seven days a week, 24 hours a day. One of them is a 520-hp cross-drum Springfield, one is a 500-hp Union Iron Works water-tube, the third is a B&W 608-hp integral-furnace type, and the fourth is a B&W 520-hp water-tube boiler. All are equipped with Indiana rotary cup oil burners, and as evident from the flow diagram all burn oil or the sludge-oil combination.

Heated fuel oil, ready to burn, is constantly circulated through the line to the boilers, so that the fuel burned may be changed at a moments notice.

The lines from the blending tank to the burners, and the recirculating lines, are all jacketed with low-pressure steam, which both prevents solidifying in the event the flow is stopped, and keeps the fuel at the proper temperature for burning. The steam jacket is insulated, of course. These lines are under the boiler room floor.

Because there is a percentage of solid impurities in the fuel, the fire appears somewhat sparky. Combustion is good, however, and the flue gas temperature is not excessive. The fluffy deposit on the tubes is easily removed by regular soot blowing, as described above. In order to keep this deposit fluffy, an additive known as KOR is used, introduced into the suction of the circulating pump in the proportion of one qt per 1000 gal.

There is a slow accumulation of waste material on the burner tip. When this is periodically removed by the firemen, using a hooked steel rod, and without interrupting the burning, no difficulty is encountered. There may be some decrease in nozzle life, however, due to the impurities present in the fuel.

We are indemnified by agreement with the supplier against any loss suffered by clogging of the system by the sludge. When this has happened, it has been traceable to improper operating conditions, as a rule, and we feel that this situation can be avoided. The indemnity furnished includes any fuel lost, and the furnishing of plasticizer to liquidate the sludge at the price of No. 6 fuel oil. Since this product is eventually burned, and has a very high heat content, this protection is adequate.

It is interesting to note that the supplier of this material made considerable effort to burn it in his own boilers, but was not successful in arriving at a practical system. No doubt had our plant not had the experience of burning a wide variety of marginal fuels over a number of years, we would have met similar discouragement. Such things as jacketed piping, proper additives and mixtures, and circulation in the blending tanks are tricks of the trade which we have accumulated over a considerable span of time.

Our present source of sludge is not unlimited, but we are told by our supplier that this and similar materials are available in a number of locations within economical shipping distance of our plant. So it is likely that we shall continue to burn such fuels for some time to come. THE END

Fig. 4. This can happen, too. Sediment draining from tank. Note jacketed pipe

QUESTION FROM READER A. L.

WHEN our steam power plant was revamped and modernized 15 years ago, a deaerating heater operating at 95 psia constant pressure was added to the installation. It was impossible to locate it at an elevation sufficient to provide the required NPSH to the boiler feed pumps, and a line was provided to inject some 227 F water into the suction line of the pumps.

Just how did this injection overcome the lack of sufficient NPSH?

Does such an injection have any harmful effects?

How can we determine the minimum amount of injection required?

This article gives the answers to these questions and shows how to calculate the NPSH and the effect of injecting water at various temperatures into the pump suction.

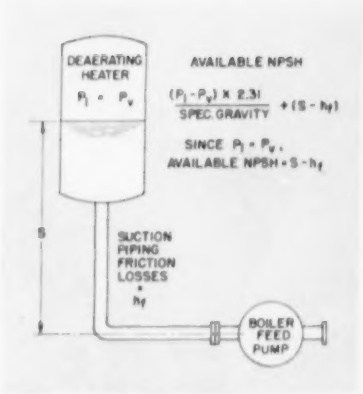

DEAERATING HEATER
$P_i = P_v$
AVAILABLE NPSH
$\frac{(P_i - P_v) \times 2.31}{\text{SPEC. GRAVITY}} + (S - h_f)$
SINCE $P_i = P_v$,
AVAILABLE NPSH = $S - h_f$
S
SUCTION PIPING FRICTION LOSSES = h_f
BOILER FEED PUMP

Fig. 1. Available NPSH when pump takes suction from deaerating heater

How Do You Get Correct NPSH on a Pump?

By IGOR J. KARASSIK*

THE REQUIRED NPSH or net positive suction head is the energy in feet of the liquid pumped which must be made available over and above the vapor pressure of the pumped liquid in order to avoid flashing and cavitation in the centrifugal pump impeller.

On the other hand, the available NPSH of a system is the difference between the suction pressure and the vapor pressure, and can be expressed as:

$$\text{Available NPSH} = \frac{(P_i - P_v) \times 2.31}{\text{Spec. Gravity}} + (S - h_f)$$

where:

P_i = Pressure in the suction vessel.

P_v = Vapor pressure at pumping temperature.

S = Static elevation from suction vessel liquid level to pump centerline.

h_f = Friction losses in the suction piping.

Then, if H_s is the required NPSH for the boiler feed pump, proper operation will only be assured if:

$$\frac{(P_i - P_v) \times 2.31}{\text{Spec. Gravity}} + (S - h_f) \text{ is greater than or equal to } H_s$$

Inasmuch as in a direct contact deaerating heater, the pressure P_i is substantially equivalent to the vapor pressure P_v, the only available NPSH is represented by the difference between the static head S and the friction losses h_f, as illustrated in Fig. 1. It is obvious that in many cases, physical limitations will reduce the value of S to a nominal amount, possibly insufficient to provide sufficient NPSH.

One of the solutions employed in some cases to overcome this difficulty is to inject colder water into the pump suction. This has for effect the lowering of the vapor pressure and, therefore, an artificial increase in the available NPSH. The method is referred to as "sub-cooling."

The two charts illustrate the effect of colder water injection upon the available NPSH. The first, Fig. 2, illustrates the effect of sub-cooling (or temperature drepression) upon the available NPSH at various initial feedwater temperatures. The second, Fig. 3, shows the temperature depression resulting from cold water injection, plotted against the difference in temperature between the feedwater and the injection stream and given for varying ratios of injection flows.

For instance, if it were desired to

*Assistant to vice-president, and consulting engineer, Harrison Division, Worthington Corp

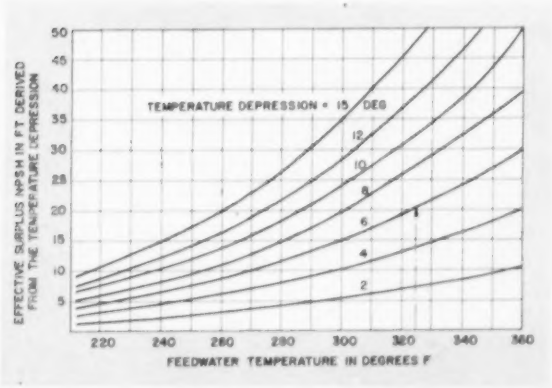


Fig. 2. This chart and Fig. 3 show the effect of colder water injection on available net positive suction head (NPSH). Here is effect of sub-cooling at various initial feedwater temp

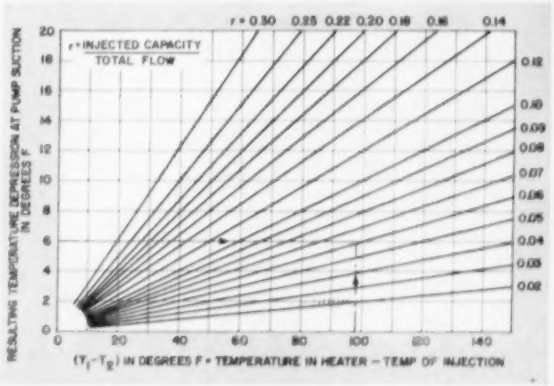

r = 0.30 0.25 0.22 0.20 0.18 0.16 0.14
r = INJECTED CAPACITY / TOTAL FLOW
RESULTING TEMPERATURE DEPRESSION AT PUMP SUCTION IN DEGREES F
$(T_i - T_s)$ IN DEGREES F = TEMPERATURE IN HEATER − TEMP OF INJECTION

Fig. 3. This chart shows temperature depression from cold water injection, plotted against the difference in temperature between feedwater and injection stream, various ratios

provide 20 ft additional NPSH to the pump in question which handles 325 F feedwater, the required temperature depression is 6 F. The injection water temperature is 227 F, giving us a 98 F difference between feedwater and injection water temperatures. From Fig. 3 we can see that the injection flow must be 6.2 per cent of the total feedwater flow.

The colder injection flow must obviously be taken from the upstream side of the feedwater cycle, ahead of the deaerating heater. To introduce non-deaerated condensate into the boiler feed pump suction is not recommended, especially in the case of high pressure boilers where the possible effects of oxygen contamination may be quite severe. On the other hand, it may be that the deaeration provided in the condenser hot well is reasonably good, in which case the introduction of a little over 6 per cent water which has bypassed the deaerating heater may not have serious results. The above installation has operated in this manner for 15 years.

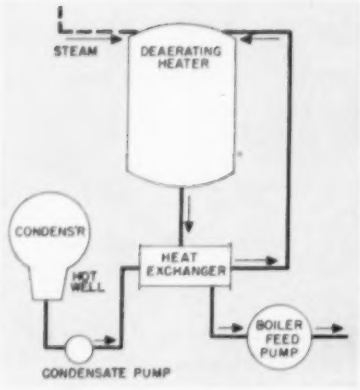


Fig. 4. Sub-cooling system which uses plant's condensate as cooling medium

Of course, if it were desired to eliminate entirely any possible oxygen contamination, it would be possible to install a heat exchanger in the suction piping, so as to sub-cool the feedwater without introducing any contamination therein. To the desired added available NPSH should be added the friction loss through the heat exchanger and the amount of sub-cooling necessary, from Fig. 2.

In order to avoid wasting the heat by the sub-cooling process, the cooling medium employed can be the condensate itself, on the way to the deaerating heater, Fig. 4. THE END

Front Street Uses New Desuperheater In Turbine Bypass

ADJUSTING the temperature of part of the exhaust from a topping turbine to design conditions for a low-pressure unit is the job given to the first of a new type of desuperheater developed by Copes-Vulcan. The desuperheater is used in conjunction with a Type CV-D pressure reducing valve to supply steam to a 12,500-kw turbine generator in the Front Street Station, Erie, Penna., of Pennsylvania Electric Co.

Maximum specified operating conditions at the pressure reducing valve are 275 psig and 700 FTT. With inlet pressure varying between 200 and 275 psig, normal pressure leaving the valve was to be maintained at 190 psig with regulation, fully closed to wide open, not to exceed 5 per cent. At this pressure reduction, the valve was to pass a maximum flow of 165,000 lb per hr at inlet conditions of 250 psig and 675 FTT, and a flow of 125,000 lb per hr at inlet conditions of 200 psig and 650 FTT.

The desuperheater was specified to handle a steam temperature range of 510 to 700 FTT, and to maintain a discharge temperature of 510 FTT with a maximum variation of ±5 F throughout a range of steam flow from 5,000 to 165,000 lb per hr. It was later found desirable to hold the discharge temperature at 490 FTT, other conditions remaining the same.

During actual operation over a period of 15 months, the pressure conditions have been met consistently, and the desuperheater has maintained a discharge steam temperature of 490 FTT even though the inlet temperature varied between 600 and 650 F. Controlled temperature has remained within limits of ±3 F at all times, with standard commercial instrumentation employing proportional and reset control.

The desuperheater is connected about 20 ft upstream from the turbine throttle and final steam temperature is measured just ahead of the steam-chest nozzle. Desuperheating water is supplied from the feedwater heater at 1,500 to 1,600 psig and 300 F, and regulated automatically by a Type CV-D valve.

The desuperheater is a 10-in., 300-psig standard Copes-Vulcan variable-orifice design. It consists of a section of steel pipe enclosing a self-regulating orifice extending around the full 360 deg, and a weighted ball held in concentric position by Inconel springs. Cooling water under control of the temperature regulator enters the orifice chamber at a uniform rate of flow around the full periphery.

In operation, the force of the steam flowing through the desuperheater raises the ball an amount determined by the weight of the ball and quantity of steam flowing. Each rate of steam flow gives the ball a different position, with almost constant pressure drop, normally 3 to 4 psig, for all flows.

Cooling water enters the steam at the seat of the orifice, the point of highest pressure drop. The result, it is claimed, is high turbulence regardless of rate of flow, with instant and intimate mixing of cooling water into the steam for complete vaporization. Since the desuperheater body is always mounted vertically, water not immediately absorbed is said to remain in suspension until completely dissipated.

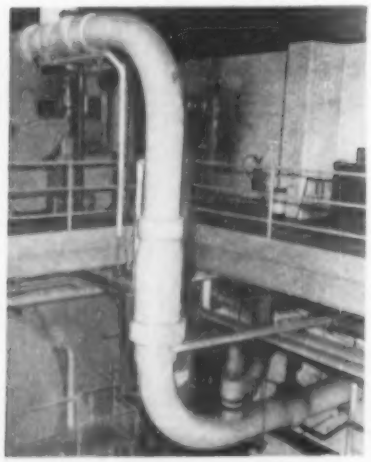


Fig. 1. Variable-orifice desuperheater installed on steam header supplying 12,500-kw turbine generator at Erie

Fig. 2. Phantom view of new variable orifice desuperheater showing ball and springs, water connection at orifice

Fig. 1. Long Beach, Cal., Steam Plant has sunk almost 25 ft. Stairway right and levee left indicate change. Steel towers are oil derricks

Power Plant Sinks Below Ocean Level

. . . but original good engineering holds equipment in alignment

OVER THE PAST 20 years, southern Los Angeles County (Calif.) has been experiencing an extensive and serious land subsidence accompanied by horizontal movements. This phenomenon has been most serious in the Long Beach area, where an egg-shaped bowl has formed, with its center, or lowest portion, at the easterly end of Terminal Island.

Main cause for the subsidence is the removal of oil and gas underground, by extensive oil field operations, with a resulting decline of fluid pressure in the oil reservoirs.

By March, 1957, an area of 16 square miles, covering part of the city of Long Beach and all developed portions of the Port of Long Beach, had subsided from 2 to 24 ft, with the sinking intensified at Terminal Island.

From 1931 to 1945, the easterly end of Terminal Island subsided 4.2 ft, and dikes became necessary to protect the low areas from high tide. The annual rate of subsidence at Terminal Island was 2.4 ft for 1950–51, had tapered off to 1.3 ft for 1956–57; and experts have predicted that the total subsidence at the Terminal Island area will be from 30 to 35 ft by 1970, after which time the rate of subsidence will be low.

Located on Terminal Island is the Long Beach Steam Plant of the Southern California Edison Co. Today the plant has sunk almost 25 ft from its original level, and is now below ocean level. What effect has this had on the plant and its operation?

Fig. 2. Some of Long Beach's many oil pumps being "raised" to level above high tides. Subsidence varies 2 to 24 ft

Remarkably enough, the answer is, very little. Careful design and construction in the first place (though subsidence as a problem was not then recognized) has seen the plant through this unusual situation with practically no loss in output. Stone & Webster Engineering Co was in charge of the original job; and when subsidence became a real problem, Southern California Edison undertook work to relocate the cooling pipes and to build dikes.

The plant units are built on a thick concrete mat supported by piles. Since the mat has not broken, the plant has subsided as a whole, and is holding fairly well. At the last two overhauls it has been found necessary to shim the units of Plant No. 3 by about 228 mils, but the company is inclined to attribute this need for realignment to differential foundation movement.

Of course, since the plant has subsided below the level of the ocean, all drain lines now require pumping. The drains are led to sumps, from which the water is pumped to the ocean. There are some 49 pumps with capacities from 100 to 1500 gpm.

The company has provided for emergency handling of pump outages as follows: many of the sumps have two pumps; some of the pumps are cross-connected; portable pumps are on hand.

The original underground circulating water tunnels have been replaced with cement conduits above ground. These conduits contain expansion joints. The effects of stresses can be seen before there is any damage, and corrective action taken.

Many of the utility lines have also been placed above ground, and are well protected with expansion joints. Expansion joints have been installed in the lines that are still underground. Regular inspections are made of all lines and expansion joints, in an effort to schedule corrective action before the lines break.

Having spent some $7,000,000 to protect the station against subsidence, the Edison company has no intention of deserting the Terminal Island site. It is the company's expectation that when the Long Beach plant reaches its normal retirement — and with the abatement of subsidence — it will then be replaced by a new and modern plant on the same site. THE END

Boiler Plant Too Small?

Here's how one plant was expanded . . . and how much the job cost. This is sixth and last of a series which began in the May 1957 issue, on the costs of modernizing small industrial power plants

By H. D. FISHER*

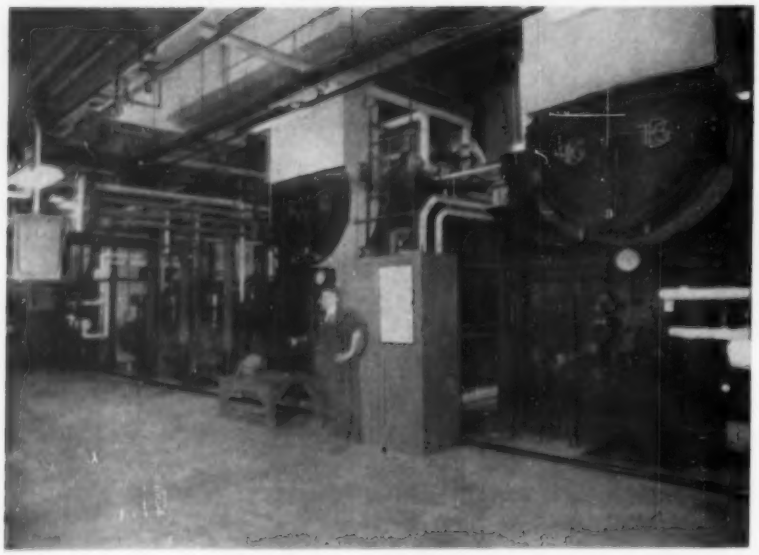


Fig. 1. This view shows the three existing boilers of Plant F (one is at extreme left end of firing line, separated from others by air compressors) presented the problem of an estimated deficiency in capacity of 15,000 lb/hr

Fig. 2. Tarpaulin covers opening for taking in completely assembled boiler

Fig. 3. Addition made room for one new boiler with 21,000 lb per hr capacity

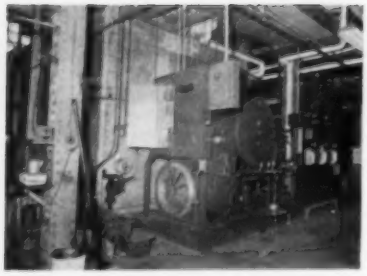


Fig. 4. New boiler has high efficiency oil burner unit with automatic control

THIS INSTALLATION formed an addition to a boiler plant which had been built about 1946 to supply heating and process steam for a manufacturing plant making metal and electrical specialties. The existing plant had become too small because of expansion of buildings and manufacturing facilities, the shortage being most noticeable in process steam. The new boiler installation was designed to supply this shortage and the needs for heating additions to the building, for which plans had already been made.

Former plant consisted of one 211-hp horizontal return tubular boiler operated for process steam at 60 lb, and two so-called two-pass fire-tube boilers rated 225 hp for heating steam at 5 to 10 lb. The estimated deficiency of steaming capacity, when expansion plans that had already been made were completed, was 15,000 lb per hour, and it was decided to install one boiler of a capacity to supply all process steam, and the deficiency of heating through a reducing valve, resulting in a new boiler capacity of 21,000 lb per hour. This would result in the horizontal return tubular boiler being available at least as a partial spare, a feature which had not previously existed.

The three existing boilers stood in line on one side of a firing aisle which in turn fronted on a yard partly occupied by one-story frame storage sheds. The boiler house addition was planned to extend into the yard along this side, with a roof monitor where it joined the existing building, and to be large enough for an additional boiler of the same size and additions to the air compressor installation, which is housed in the boiler

*Consulting engineer, Westcott & Mapes, Inc., New Haven, Conn.

COST OF EXPANDING PLANT F — 1953

Boiler, Bigelow Co type B, capacity 21,000 lb per hour continuous, 23,000 lb per hour for 4-hour overload, 125 lb design, including Stets feedwater regulator and soot blowers, shop assembled delivered and put in place on owner's foundation	Bigelow Co	$28,224
Oil burning equipment, including oil pump, steam and electric oil heaters, forced draft fan, automatic starting and modulating control flame failure device, steam and oil piping connections to owner's system, electrical wiring and thermal insulation	Peabody Engineering Corp	10,835
Boiler flue delivered and erected	Bigelow Co	1,832
Building addition and boiler foundation	W. V. Stapleton	23,380
Deaerating feedwater heater, 40,000 lb per hour with 10,000-lb storage tank.	Graver Water Conditioning Co	4,555
2 boiler feed pumps, 15-hp motors	Pennsylvania Pump and Compressor Co	1,494
Piping, for steam and water including relocating and connecting three air compressor receivers on boiler house roof, delivering feedwater heater from RR yard, placing on support and connecting, placing boiler feed pumps and connecting, reducing valve station to heating system and drip drains and vents as required	Bridgeport Pipe Engineering Co	17,740
Insulation for piping, boiler flue and heater	Homestead Insulation Co	3,630
Lighting and power wiring	Owner's maintenance force	2,000
Engineering	Westcott & Mapes, Inc	14,097
Engineering expense		223

Amount of estimate . . . $121,275 Total Cost $108,010

Cost per pound per hour of normal steaming capacity—$5.14. This is weighted a little by the extra-sized building for possible future boiler and compressor installations, and by oversized heater and boiler feed pumps.

house. Figure 2 shows the exterior of the addition. The tarpaulin covers the opening for taking in the boiler, which was delivered completely assembled. This opening was eventually filled with a removable cinder block wall.

driven boiler feed pumps. Condensate pump discharges were redirected into the feedwater heater which is shown in Fig. 5. To obtain sufficient net positive suction head for the boiler feed pumps it was located in the monitor at the end near the

manufacturers, so no question of favoritism was involved. The new boiler is shown in Fig. 3, though partially obscured by the control panel for the old boilers.

Steaming capacity of the boiler is large enough to warrant the installation of a high efficiency type of oil burner with air register, forced draft fan and automatic control. The burner unit is shown in Fig. 4. Existing oil tankage, consisting of two 20,000-gal underground tanks, was adequate and the suction and return lines of the new burner were connected into them, the piping and oil tank gages showing on the far wall of the boiler room in Fig. 3.

Steel plate flue with bolted end plate for extension in case an additional boiler was installed, connected this boiler to the existing flue near its entrance to the stack.

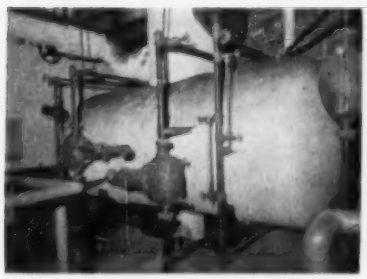


Fig. 5. Deaerating feedwater heater was located in monitor at end near stack

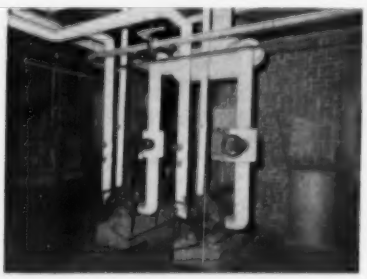


Fig. 6 Boiler feed pumps on the firing floor just below the feedwater heater

Figure 1 shows the existing boiler installation, the heating boilers at the right, the air compressors beyond them, then the return tubular boiler.

Heating system boilers had been fed by condensate return pumps throughout the factory with makeup from the city water system, and the return tubular boiler by a self-contained feed pump and heating unit. It was realized that a water tube boiler is much more sensitive to oxygen in the feedwater than a fire tube boiler; the boiler feeding system was therefore revised to include a deaerating feedwater heater and motor-

stack, with the boiler feed pumps shown in Fig. 6 on the firing floor below it.

Attendance and supervision in the boiler house is such that it didn't seem advisable to install boilers requiring very precise feedwater conditioning. Therefore relatively large diameter furnace wall tubes, moderate rate of furnace heat release, and low heat transmission rate in a boiler of this capacity, which could be shop assembled and readily transported, made the Keeler type-CP seem especially suitable. This type is made under license by several boiler

WANT TEAR SHEETS?

Taken together, this series of case histories by H. D. Fisher on costs of modernizing industrial power plants, covers a useful range of comparative situations. Steam load problem handled in each case was as follows:

May: 24,000 lb/hr, 125 psi
June: 50,000 lb/hr, 150 psi
July: 30,000 lb/hr, 125 psi
August: 120,000 lb/hr, 190 psi
October: 25,000 lb/hr, 180 psi
November: 21,000 lb/hr, 125 psi

WRITE THE EDITORS, POWER ENGINEERING
308 East James Street, Barrington, Ill.,
or jot Modernizing Costs on return postcard elsewhere in this issue

Power Engineering handbook

More Points on Lubricating Elevator Ropes*

BY PAUL C. ZIEMKE

U-GROOVE traction elevators depend on a firm contact between cable and the drive sheave groove. Since the friction established is the means of transmitting the motor's power to the car, the cables must not slip. In fact, the tractive ratio most often used in service is so low that to use any lubricant that would reduce the coefficient of friction of the cable, would lead to cable slippage.

There are several special lubricants, minus the abrasive, that have been produced through extensive research by the American Chain & Cable Co. An outstanding type is called H-C Colorless Compound and has proved most effective for the special applications common to double-wrap traction machines. As the name implies, the material is colorless, which permits minute inspection of the cable for its full length. It is not water soluble, and can be removed at will by the use of any of the numerous hydrocarbons used for degreasing.

V-Groove Lubrication

With this type of machine, the cable is subjected to the greatest pressure and lateral distortion just as it enters the V-groove. The lateral forces inducing the temporary distortion cause what may well be considered as the maximum movement of wires and strands. Under these conditions, there is simultaneous maximum movement of wires and strands with the occurrence of high pressure; so it is imperative that a good choice of lubricant be used, and at intervals spaced so that the cables will not run dry.

A tell-tale condition is present when light gray flakes of metal drift into the car through the ventilation ducts, or gather in quantity on the penthouse floor beneath the drum. It is *not* necessary to sacrifice cable life in order to maintain top values in coefficients of friction. Almost inevitably when cars stall due to cable slippage, someone has erred seriously in operating under overload conditions, attempting to "pull-out" a car with under-car safety device tripped, or by using the wrong type or too much lubricant.

If the wrong grade or type of lubricant is used, or if the cable is not lubricated sufficiently, the result may be noted in severe fatigue stresses concentrated in that area of the cable that is below the actual point where the cable contacts the V-groove. It is logical to assume that the stresses can be laid to the fact that the strand distortion was induced in the absence of sufficient lubrication to permit the free motion of all wires within that strand.

The oil must hold its film of lubricant against the flowing action of the high pressure met in this service. It must prevent undue scouring, and give protection to the walls of the grooves

* See also the author's article on this subject, in POWER ENGINEERING's Handbook, October 1957, page 98.

fold along this line—outside edges toward you

It is natural to assume that the lubrication periods for V-groove machines should be more frequent than for U-groove machines. Only a close study of the individual installation will reveal the best spacing of lubrication periods. In some operations the work load fluctuates with the change of season and compensations must be set up or time and materials are wasted.

Ordinary Drum-Type Machines

With this equipment we have no concern over coefficients of friction to maintain traction. Rather, the only concern is to keep a tough, durable film of oil about each cable strand to permit the whole cable to work like a machine, which it is. As with machine bearings, we wish to avoid metal-to-metal contact.

Here we can utilize the heavier-bodied lubricants providing we do not select a grade that will oxidize and become tacky, attracting dirt that will act much like the abrasive mentioned above. If the material packs in the grooves so that the cable looks like a smooth pipe rather than the twisting strands we associate with wire rope, an outer shell has begun to build up that prevents penetration of applications of lubricants to the hemp core, right at the point where it is needed the most.

That solid outer glaze is also a trap to hold moisture, under the peculiar conditions under which some cars must function. Temperature and humidity changes permit some ropes to sweat and when this happens the entrained moisture can readily rust the interior strands, all neatly concealed under the disguising coat of rope lubricant. A close scrutiny will reveal the fact that the old coating has cracks and fissures as the rope flexes over the drum. These openings breathe in moisture much as an accordion takes in and discharges air; only too much dampness remains in the dry hemp center.

Why Ropes Fail Prematurely

Since lack of lubrication stands at the head of any list of reasons for early rope failure, we'll place it there. Failure to lubricate permits the core to dry out which in turn permits corrosion.

Then the use of too much lubricant on ropes for U-groove machines produces slippage; and improper or insufficient lubrication of ropes on V-groove machines causes failure to encourage movement of stresses in wires, thus permitting metal-to-metal contact.

Lack of equalization results in a creeping action of the lightly loaded cables, increasing wear on sheave and cables, and increasing individual wire breaks.

Jerky operation or excessive acceleration, brought about by failure of current-limiting relays to function along prescribed time functions in relation to current drain and speed, results in stretching the cable and reducing its diameter.

Careless brake adjustment causes action comparable to that of excessive acceleration, only in reverse order.

Cast iron sheaves tend to show the grooves left by the individual "lays" or strand groups as they pass over. Loose bearings permit the rope to work to one side and produce thin-sided sheaves. Other sheaves pinch the cable. This is especially true if both rope and sheave wear in together; then the new, full-sized rope will pinch.

Use of run-of-mine rope will not serve effectively in elevator operation. Rope must have design features that suit the work under the conditions common to passenger service. Obviously, a round rope is desired for maximum traction.

Light loading of governor and compensating cables is a condition that can lead to many obscure wire failures. Additions to loading may lessen the deterioration.

Improper tensioning of ropes at the time of installation results in some of the ropes "hogging the load" and applying excessive wear on the drum grooves. While the wear, in a fashion, compensates for the taut lines, it does produce a prematurely-aged rope, and when subsequent re-reeving is done properly great difficulty is encountered in establishing uniform tensions. The excessively worn grooves also lack proper tractive effort.

Correction: In the Handbook section for September, page 94, appeared the title Wrinkle Bending of Malleable Pipe. Our good friend Sabin Crocker, author of the famous Piping Handbook, says: "Am doubtful about bending 'malleable pipe.' Maybe you meant steel pipe or wrought pipe." Yes, that's what we meant and we don't know how that word malleable got there. Please cross it out in your copy. — *The Editors.*

cut along this line

THE PERFORMANCE RECORD *Speaks* FOR ITSELF!

Cochrane CBA Condensate Drainage Control Pump

There are hundreds of case histories to prove the amazing benefits Process Industries derive from the Cochrane C-B System. The effectiveness of this system for improving heat transfer from steam is almost unbelievable!

For example:

- Unit installed on a paper machine saves 20 tons of coal a day while increasing machine drum surface temperature from 260° F to 310° F!
- Canner increased production of jacketed kettles 50%!
- Candy manufacturer doubled its plant production!
- Corrugating plant increased output of double-wall board 61%!
- Recovery plant eliminated the need for one of its two boilers!
- Chemical plant increased drying speed of drum dryer 44% with no wet spots, while increasing boiler capacity and saving $200 a month on fuel!

The Cochrane C-B System assures fast, uniform heat transfer. Condensate can be returned to boiler or make-up system at process temperature, resulting in higher efficiency, increased production and lower steam costs.

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New Jig Simplifies Welding of Boiler Fin Tubes

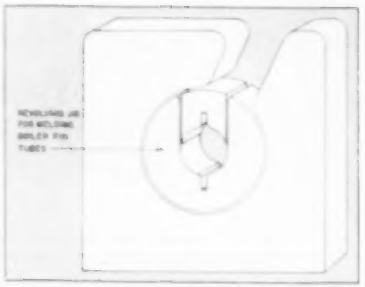
THE BUREAU OF SHIPS JOURNAL points out that a great deal of time is required in handling, positioning, clamping down and straightening a fabricated boiler fin tube before it becomes a finished product.

Now Joseph Eunice and Stanley Choy, employees of the San Francisco Navy Yard, have developed an ingenious jig that eliminates the clamping part of the process.

Ordinarily, fin tubes are placed in a jig, fastened down, and welded. After the welding is completed on one side, the tube is transferred to another jig so that the opposite side can be welded. When welding is completed, the tube is straightened.

The new jig, shown in the figure, positions and secures the tube so that the welder can proceed from one side to the other and from end to end without stopping.

One welder, unaided, can completely weld a fin tube simply by revolving the work.



When tube is completely welded, it is easily removed from jig, usually does not need straightening

How To Get Economy Through Proper Pump Maintenance

CAREFUL USE of equipment purchased has to prolong its life and value to you. If you follow the manufacturer's instructions on lubrication, preventive maintenance, and use the product as it was designed to be used, you will profit through the years. For this reason, *The Yeomans Guard* offers the following rules and schedule for maintaining your centrifugal pumps.

1. If there's any danger that foreign matter (sticks, refuse, etc.) may be sucked into the pump — clogging or wearing the impeller unduly — provide the intake end of the suction piping with a suitable screen.

2. Never pump a liquid for which the pump was not designed.

3. Keep the right amount of the right lubricant in bearings at all times. Follow your pump manufacturer's lubrication instructions to the letter.

4. See that pump and motor coupling flanges are parallel vertically and axially, and that they're kept that way.

5. Any down-sloping toward the pump in suction piping should be corrected, as it could reduce capacity and cause vibration.

6. See that piping puts absolutely no strain on the pump casing.

7. Never allow a pump to run dry (either through lack of proper priming when starting or through loss of suction when operating). Water is a lubricant between rings and impeller.

8. Examine wearing rings at regular intervals. When seriously worn, their replacement will greatly improve pump efficiency.

9. Packing should be replaced periodically — depending on conditions — using the packing recommended by the manufacturer. Forcing in a ring or two of new packing instead of replacing worn packing is bad practice. It's apt to displace the seal cage and score shaft or shaft sleeve, as well as draw more power.

10. Never tighten a gland more than necessary. Excessive pressure will wear shaft sleeves unduly and use extra power.

11. If shaft sleeves are scored badly, replace them immediately, or packing life will be entirely too short.

12. If the liquid being pumped contains grit, a separate source of sealing liquid should be obtained (e.g., it may be possible to direct some of the pumped liquid into a container and settle the grit out).

Relative Timetable

Pumps will give the best service when a preventive maintenance schedule is followed. Actually, operating conditions vary so widely that to recommend only one schedule of preventive maintenance is highly impractical.

This schedule applies to the most severe applications, and can be modified as necessary.

Every Year

Remove rotating element and inspect thoroughly for wear — ordering replacement parts if necessary. Check wearing ring clearances — generally, they should be no more than 0.003 in. per inch on diameter of wearing rings.

Remove any deposit or scaling. Clean out water seal piping.

Measure total suction and discharge lifts as test of pipe conditions. (Record figures so they may be compared with figures of next test).

Inspect foot valves and check valves — especially check valves which must safeguard against water hammer when pump stops.

Every 6 Months

Replace packing with grade recommended by the manufacturer. Make sure seal cages are centered in stuffing boxes at the entrance of water seal piping.

Check shaft sleeves for scoring that would accelerate packing wear.

Check alignment of pump and motor, and shim up units as needed. (Check entire piping system if misalignment recurs frequently). Unbolt piping at suction and discharge nozzles to see if it springs away — indicating strain on casing. Check all piping supports for soundness and effective support of load.

Every 3 Months

Drain lubricant, wash out oil wells and bearings with kerosene. In the case of sleeve bearings, check to see that oil rings are free to turn with the shaft. Repair or replace if defective. Refill with proper lubricant.

Measure bearings for wear, replace if excessive. Generally, allow 0.002-in. clearance, plus 0.001 in. for each inch or fraction of an inch of shaft journal diameter.

Every Month

Check bearing temperature with thermometer, not by hand. If anti-friction bearings are running hot, probably they have too much lubricant. If sleeve bearings are running too hot, probably they need more lubricant. Disassemble and inspect bearing if change in lubrication doesn't correct condition, or possibly the alignment of pump and motor should be checked.

Cutting Guy Wires Safely

AN EFFECTIVE safety device for cutting guy wires has been developed by regional department crews of the Union Electric Co. A large battery clip is attached with a short length of lightweight chain to each jaw of their bolt cutters.

Then, when cutting a guy wire, one clip is fastened to the wire on each side of the bolt cutters, and the chained clips prevent the cut ends of wire from flying through the air.

Chained clips prevent cut wire flying through air

POWER ENGINEERING HANDBOOK

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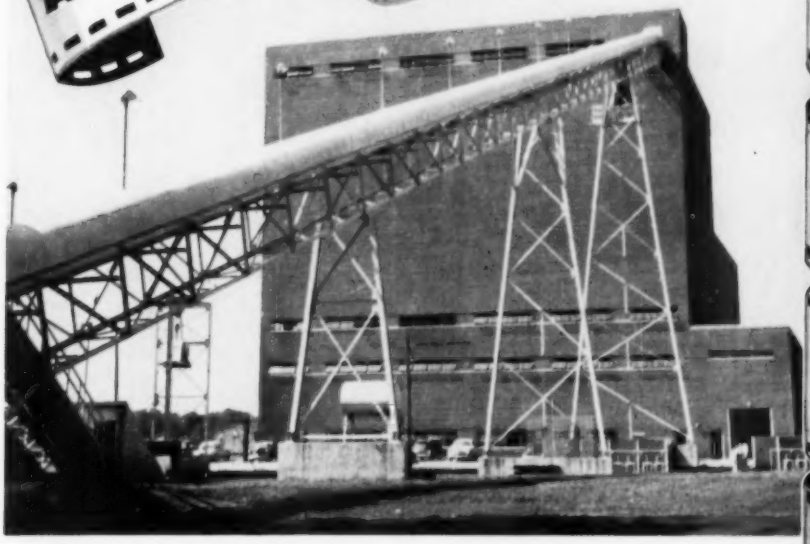
A Websterama OF ECONOMICAL COAL HANDLING



Twin track hopper receives run-of-mine coal from cars assisted by car shaker, and loads double reciprocating plate feeder.

Plate feeder discharges to inclined Belt Conveyor #1–212' long. Magnetic pulley ejects tramp iron at discharge to crusher or by-pass chute.

Under crusher, coal can be fed to Conveyor #2 or #4. Coal sampling equipment is located in chute to Conveyor #2. Inclined Conveyor #2 is 341' long from crusher house to Conveyor #3 (over bunkers in main building).

Conveyor #3, equipped with automatic self-propelled Webster tripper, distributes coal to 104' long bunker. Each compartment of bunker has Webster gate and scale to automatically record fuel used.

Stocking-out Conveyor #4 is 43' long and discharges to yard storage. Coal is reclaimed through system as previously described.

The complete coal handling system is electrically interlocked for movement of coal without fear of jam-up.

This WEBSTER 300-ton-per-hour coal handling system built for the City of Richmond, Indiana, could well be described as "an introduction to automation." It was designed to meet the most modern requirements for automatic, efficient handling of coal, with a minimum of maintenance and operational attention. In addition to the conveying system, WEBSTER also supplied the masonry crusher house, which includes dust-tight control room, locker room, bulldozer garage, plus crusher room and sampling equipment.

Whether you intend to construct a new power plant or modernize an old one, WEBSTER engineers will be pleased to cooperate with your engineers or engineering firm in applying 81 years of WEBSTER experience to your coal-handling problems. Write Dept. PE-117 today.

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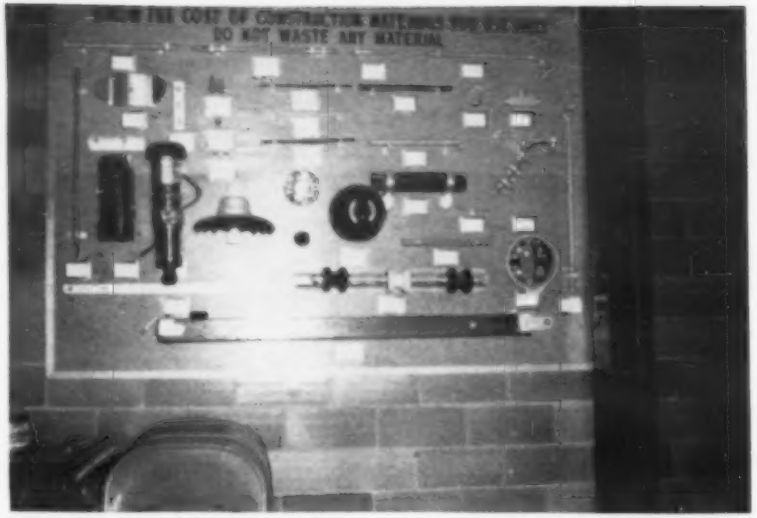

Removable labels identify the displayed items, give costs. For instance, label for lowest item on board reads: 2001-E Wood Cross Arm Brace, $1.73, for round item above it (r), Single Phase Meter Base, $5.30

Here's Way To Cut Maintenance Costs By Displaying Value of Parts

By H. NYE JOSLEYN

SPECIAL USE of a large bulletin-type display board to tell the cost and identify the more common materials used in maintenance and construction aids in cutting costs due to misuse of supplies. Time is saved and confusion avoided by proper identification. Immediate good results are seen in a more appreciative handling of valuable supplies, less misplaced and lost parts, and a more accurate calculation of the amount of material requested for individual jobs. The idea is readily adapted to all kinds of supply rooms.

This board is located just outside the entrance of a midwest power distribution supply room adjacent to a large steam turbine-generating plant. When the board was first put into use the sign at the top questioned, Do You Know the Value of the Parts You Use? The small removable markers near each part gave special information as to vulnerability or quantity used for various periods. The cost was questioned but not given.

After three weeks the heading at the top was changed to its final version (Know the Cost of Construction Materials You Use Daily. Do Not Waste Any Material) and the markers were changed to give the cost of each part. The cost of similar material of different size was included on the identifying cards.

The parts are changed from time to time as interest lags or to obtain emphasis on parts not originally included. In this way attention is called to the smallest washer as well as to equipment too large to be mounted. Pieces too heavy or bulky to fasten on the board are set on skids underneath it.

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Burn Pulverized Coal?

Here's How To Prevent Fires in the System

FROM NATIONAL FIRE PROTECTION ASSOCIATION'S CODE NO. 60A COVERING THE INSTALLATION AND OPERATION OF PULVERIZED COAL SYSTEMS

GOOD HOUSEKEEPING is a factor of great importance to safe operating procedures with pulverized-coal systems. Provision should be made for maintaining equipment in dust-tight condition, and for periodic cleaning of horizontal ledges or surfaces of building and equipment to prevent the accumulation of appreciable dust deposits.

Vacuum cleaning methods are preferred. If manual cleaning is used, care should be taken to avoid forming explosive clouds of dust in air. The use of compressed air for blowing dust from walls or other surfaces may create dangerous dust clouds, and such cleaning should be done only when other methods cannot be used, and after all other sources of ignition are eliminated.

Extreme caution should be used in operations such as cleaning out plugged burners, burner piping, pulverized-coal bins, feeders or other parts of the system. Since pulverized coal drifts freely in air, ignition may take place at considerable distance from the point of initial disturbance.

Too much emphasis cannot be placed on the hazard of welding or flame cutting on pulverized-coal equipment and lines which may be partly filled with pulverized coal. Here are some suggestions:

All deposits of pulverized coal should be removed from exterior and interior surfaces by manual methods which will avoid dispersal and the possible formation of an explosive mixture.

Exterior and interior surfaces adjacent to the area of welding or cutting operations should be thoroughly drenched with water from a fog nozzle until all such surfaces are wet.

Dampened asbestos blankets should be hung or spread in such a manner as to confine weld spatter or cutting sparks.

All welding and flame-cutting operations should be carried out under the observation of an individual who has adequate fire-fighting apparatus at his disposal, and training in its use. He should be assigned no other duties during the welding or cutting operation which he is to observe.

Putting Out Fires in Pulverizers

Fire in the pulverizer is usually indicated by an abnormal increase in temperature leaving the pulverizer. It may be caused by feeding burning fuel from the raw-fuel bin or by an accumulation of fuel in the pulverizer or piping in some position where it is not disturbed. In case of fire the manufacturer's recommendations for extinguishing the fire should be followed.

A pulverizer fire may generally be extinguished by continuing operation using cold air to the pulverizer and increasing the raw-fuel feed as much as possible, as the atmosphere inside the pulverizer and burner piping is too rich in fuel to support active combustion.

If the temperature continues to rise after 15 min of increased raw-fuel feed using cold air only, the pulverizer should be shut down by closing the valves if installed in the pulverizer discharge lines, and by stopping the raw-fuel feed, air supply, and pulverizer, as quickly as possible in the order named, being sure that all openings are tightly closed.

Steam, inert gas, carbon dioxide or water should then be introduced into the pulverizer through pipe connections provided for this purpose. Such connections should be at least 1-in. pipe. When water is used, the connection should be so located and the water flow so regulated that no disturbance of the fuel in the pulverizer is created. After the pulverizer has cooled down, the doors may be safely opened and the interior thoroughly cleaned. In no case shall a compressed air jet be used, as there may still be some burning fuel.

In a storage system with recirculated air, steam or carbon dioxide should be circulated with the fan as quickly as possible and fresh air excluded from the system. This is best done by opening the

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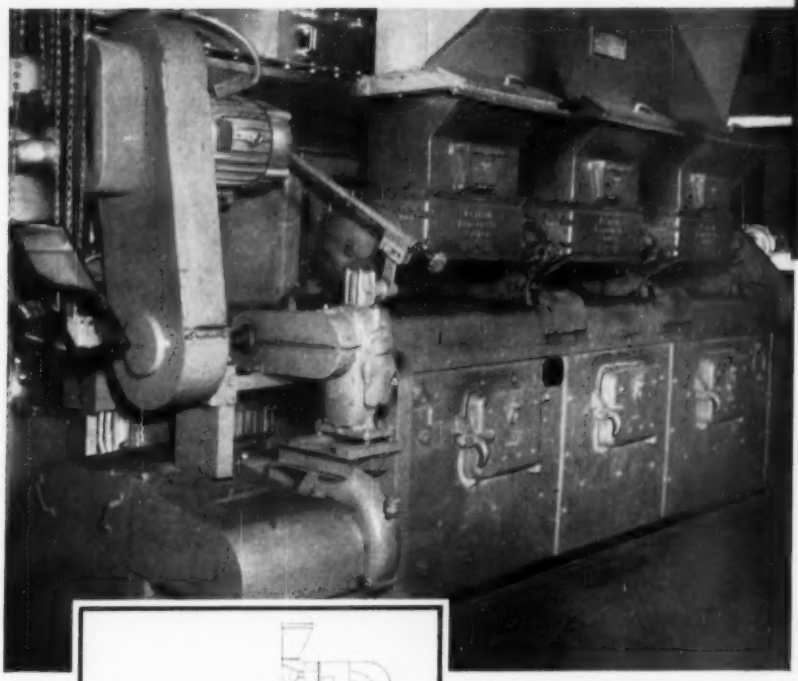
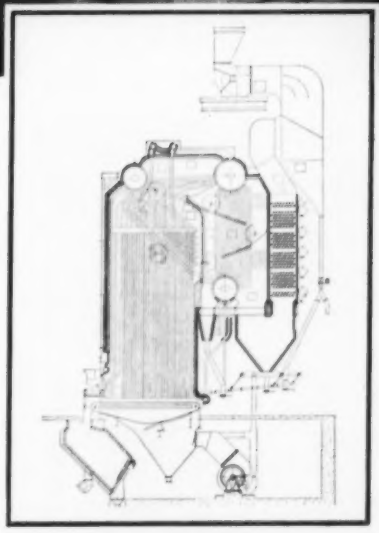
Availability?...

HERE'S A RECORD TO SHOOT AT.....Only 5 HOURS OUTAGE in 5 years



A Detroit RotoGrate Stoker



AT OTSEGO

Detroit RotoGrate Stoker with Wickes Boiler; 650 pounds pressure, 750°F temperature. Cummins & Barnard, Consulting Engineers.

This record of only 5 hours outage in over 5 years is reported by Otsego Falls Paper Mills, Otsego, Michigan, a division of Menasha Wooden Ware Corporation.

Walter Boettcher, Chief Power Engineer says: "*5 hours in 5 years and 4 months is the record of down time due to the RotoGrate Stoker outage*" in this well operated single boiler plant.

"*It operates 24 hours a day—5 to 6 days a week, 60,000 to 90,000 pounds of steam per hour.*

"*Paper mill load fluctuations handled easily without pressure loss.*"

This record indicates a fine job of equipment maintenance, but high availability can be taken for granted with the DETROIT ROTOGRATE.

A customer survey taken in all kinds of plants proves it.

DETROIT ROTOGRATE COSTS LESS

Cost = initial investment + upkeep + production losses due to outage of equipment. The total is less with RotoGrate.

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vent to the atmosphere, thus extinguishing the fire in the pulverizer and venting any explosive gas to the atmosphere.

In case a fire occurs in a pulverized-fuel bin, the bin should be sealed against air infiltration and the pulverized fuel fed out and burned if possible. Steam and/or carbon dioxide should be admitted to the pulverized-fuel bin through connections provided in each bin. Such connections to the bin shall be made of at least 1-in. pipe.

What Makes a Good Job of Design?

By J. K. PAUL

THE DUST COLLECTOR pictured below is the result of one conference plus a field trip by the design engineer to meet with the supervision staff in the carpenter shop for which the collector was made.

Note how the placement of the bulky storage bin neatly avoids the set of three windows. These windows serve the saw filing department, where a north light is traditionally important.

Note also how the vacuum line from the fan to the shop machinery did not require the expensive removal of terra-cotta tile to make an opening. By dint of a reverse bend the pipe entered the building through a window opening.

Time and material were saved by eliminating the inner concrete piers and angle iron legs, since the weight of the structure could be carried partly on two heavy angle brackets cinch anchored to the concrete beam at the center line of the hopper.

The same idea was followed in the erection of the motor structure, where the inner weight is supported by angles bolted to the light concrete beam above the windows of the truck dispatcher's office.

The hopper has a rate-of-rise perceptor, so that if a spark should set off the finely divided shavings and saw dust, the sprinkler heads will be actuated.

Dust collector is cleverly placed to avoid obscuring windows, also avoids breaking through sidewall

fold along this line—outside edges toward you

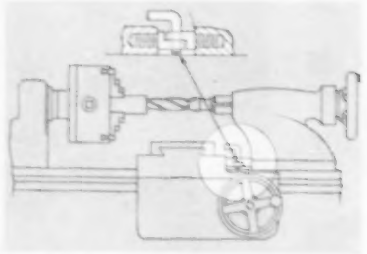
Method of Applying Power-Feed to the Tailstock

By F. E. RILEY

PUSHING large drills through the work by means of the tailstock barrel hand-feed can be very laborious, and many firms rough drill the work in a radial drilling machine before passing it to the lathe operators for final turning. When such facilities are not available, the method of applying power-feed to the tailstock, as illustrated in the figure, can be adopted.

The lathe carriage and the tailstock base are connected together by means of the simple coupling. This comprises two identical pieces of cylindrical steel each of which is threaded at one end for screwing into holes tapped into the tailstock base and the lathe saddle casting.

A half-lap joint is machined in each coupling member so that the ends can overlap. The union between the two is completed by means of the coupling pin which can be dropped into cross holes. Once fitted, the coupling can stay in position on the machine, and the pin can be used to connect or disconnect them.



Lathe carriage and tailstock base connect by simple coupling, with pin dropped in cross holes

The set-up is also useful when tapping with a tap held in the tailstock. The lead-screw drive is set to the desired thread pitch and the carriage is traversed along the bed by means of the split nut. Better quality threads are produced with a lead-screw feed.

Stuffing Box For Thermocouple

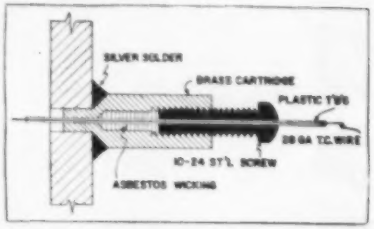
By JAMES H. POTTER

THIS INEXPENSIVE and effective stuffing box was made from odds and ends. It has been in continuous use for some time on pressures up to 100 psig and temperatures of about 100 F. The unit consists of a brass cartridge and screw through which an insulated thermocouple wire is passed.

The brass cartridge was turned from $\frac{5}{16}$-in. stock to leave a major diameter of $\frac{1}{4}$ in. and a minor diameter of $\frac{1}{8}$ in. The major part of the cartridge is 1 in. long, and connects with a 45-deg taper to the small end which is $\frac{1}{8}$ in. long. An axial hole was then drilled through the cartridge with a No. 46 twist drill. A 10-24 tap drill was then used to a depth of $\frac{7}{8}$ in. A 10-24 tap was then used for the first half inch of the stuffing box.

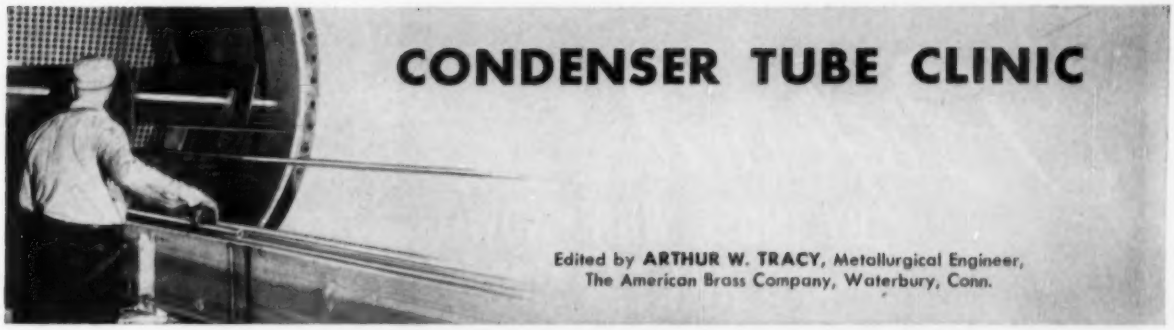
A steel 10-24 screw 1-in. long was used for a follower. The head was ground flat on two sides so that a small wrench could be used for tightening. A No. 46 drill was used along the axis of the screw also.

The 28-gage thermocouple wire was covered with high-grade plastic tubing and threaded through the assembly. Asbestos wicking was used as packing.



Brass cartridge was turned from $\frac{5}{16}$-in. stock

cut along this line



CONDENSER TUBE CLINIC

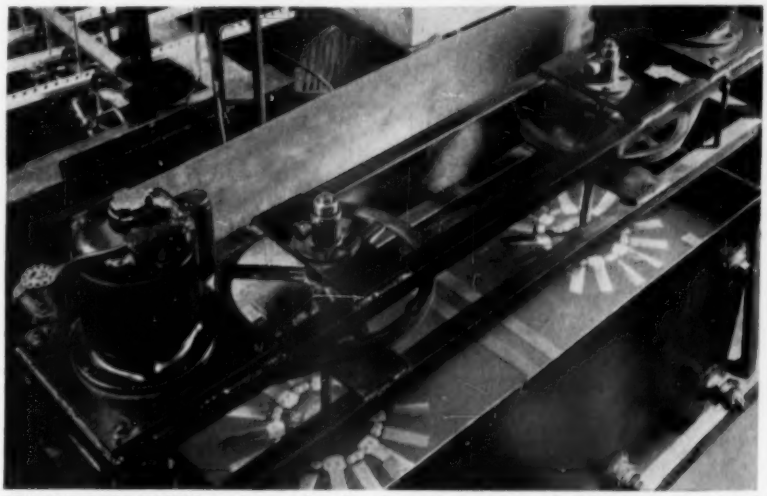
Edited by **ARTHUR W. TRACY**, Metallurgical Engineer,
The American Brass Company, Waterbury, Conn.

Some Operating Factors that affect tube life

OXYGEN AND AIR

Oxygen in the air in cooling waters is a necessary factor for corrosion to occur, but normally the presence of oxygen in solution does not cause rapid corrosion of condenser tubes. On the other hand, air in the form of bubbles can cause rapid corrosion of condenser tubes under conditions where turbulent flow is present. Air bubbles of harmful size may be produced by whirlpools in the intake tunnel, leaky packing glands on pumps, and at projections in injection pipes or water boxes. Any condition that will produce a negative pressure at some point along a tube, such as a long outlet water leg from a condenser, can also cause air bubbles to form with consequent local rapid pitting.

Sea-chest strainers may be another source of air bubbles unless designed to allow nonturbulent flow of water.



EQUIPMENT FOR TESTING condenser tube alloys for resistance to corrosion. Specimens are rotated under water to determine the effect of velocity. Further information is obtained by testing actual condenser tubes in operating condensers.

STRESSES

Stresses capable of causing stress-corrosion cracking of some alloys can be set up in tubes by thermal expansion pressure or from the rolling-in of tubes into tube sheet. It is not usually possible to change operating conditions to reduce stresses, but failures from stress-corrosion cracking can be minimized by the careful rolling-in of tubes to avoid developing high longitudinal stresses, especially when both ends of the tubes are expanded into the tube sheets.

Cyclic stresses due to vibration can cause fatigue failure of condenser tubes, and such a failure can be extremely rapid even when only tiny corrosion pits have developed on the wall of the tube. If the source of the vibration cannot be removed, the vibration of the tubes can sometimes be dampened.

GALVANIC EFFECTS

The galvanic corrosion of condenser tubes is seldom a problem because the choice of metals is usually such that the tubes are galvanically positive (cathodic) to the tube sheets and the water boxes. Any slight galvanic corrosion on tube sheets and water boxes due to their being anodic to the tubes is insignificant because of their relatively great thickness.

Zinc or magnesium sacrificial anodes are frequently placed in condenser water boxes that have been treated with paint or an organic coating to protect the iron or steel from accelerated corrosion at "holidays" or pinholes in the coating. Such anodes will generally protect the ends of the tubes from corrosion for a short distance, usually equivalent to about two tube diameters.

There is considerable experience indicating that bare iron or steel water boxes not only act as sacrificial anodes in protecting the ends of condenser tubes, but also that the corrosion products from these water boxes mixing with the tube corrosion products help build a more protective film along the whole length of the tube. Iron anodes in painted water boxes will be a source of iron compounds but will have little effect in galvanically protecting water boxes at the discontinuities in the paint film. When a new set of tubes is started in service in an old condenser where surfaces are well scaled, the use of new, clean iron anodes should aid in a more rapid formation of protective film on the tubes.

TECHNICAL HELP IN SELECTING TUBES

Your situation may require special consideration and analysis. We are always ready to help and advise in the selection of the right alloy to give best service. Address: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 8787

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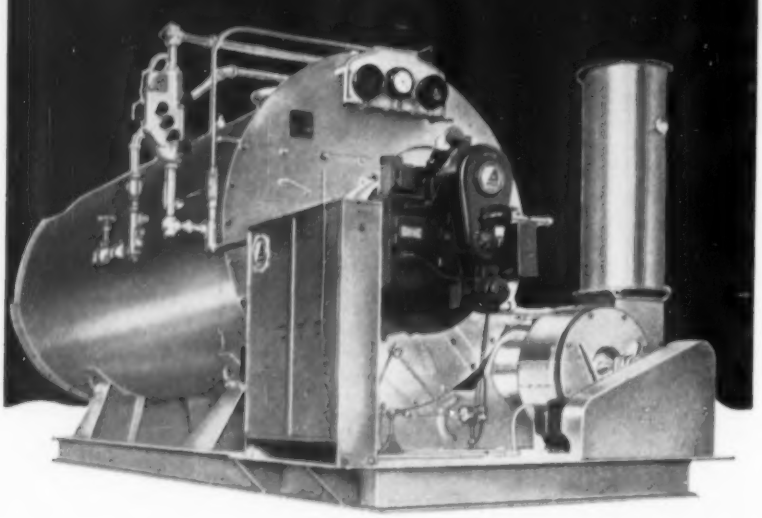

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NEW ENGINEERING BOOKS

Engineering Electronics, with Industrial Applications and Control, by John D. Ryder. First Edition, 666 pages, 6½ by 9½ in., cloth. McGraw-Hill Book Co, 330 W. 42nd St, New York, N. Y., 1957. Price $9.50.

This book provides a broad, fundamental coverage of the non-radio areas of electronics, particularly those areas of interest in instrumentation, computation, and general industrial usage. It includes the electronic fundamentals and operating principles important to computers, industrial control, and servomechanisms, without becoming an instruction book in the operation or maintenance of any particular piece of apparatus.

The emphasis throughout, is on underlying principles and basic circuits applicable to various electronic devices and equipment. The treatment is quantitative rather than descriptive or qualitative. Mathematics and circuit analysis are used to give a fundamental understanding of the material.

Although designed as a text for a senior-level college course, or for use by practical engineers in industry, there is sufficient elementary electronics provided in the first three chapters so that those lacking preliminary preparation can still use the book profitably.

* * *

Essentials in Problem Solving, by Zuce Kogan. Second Edition, 119 pages, 5¼ by 8¼ in., cloth. Published by Arco Publishing Co, Inc, 480 Lexington Ave, New York, N. Y., 1956. Price $4.00.

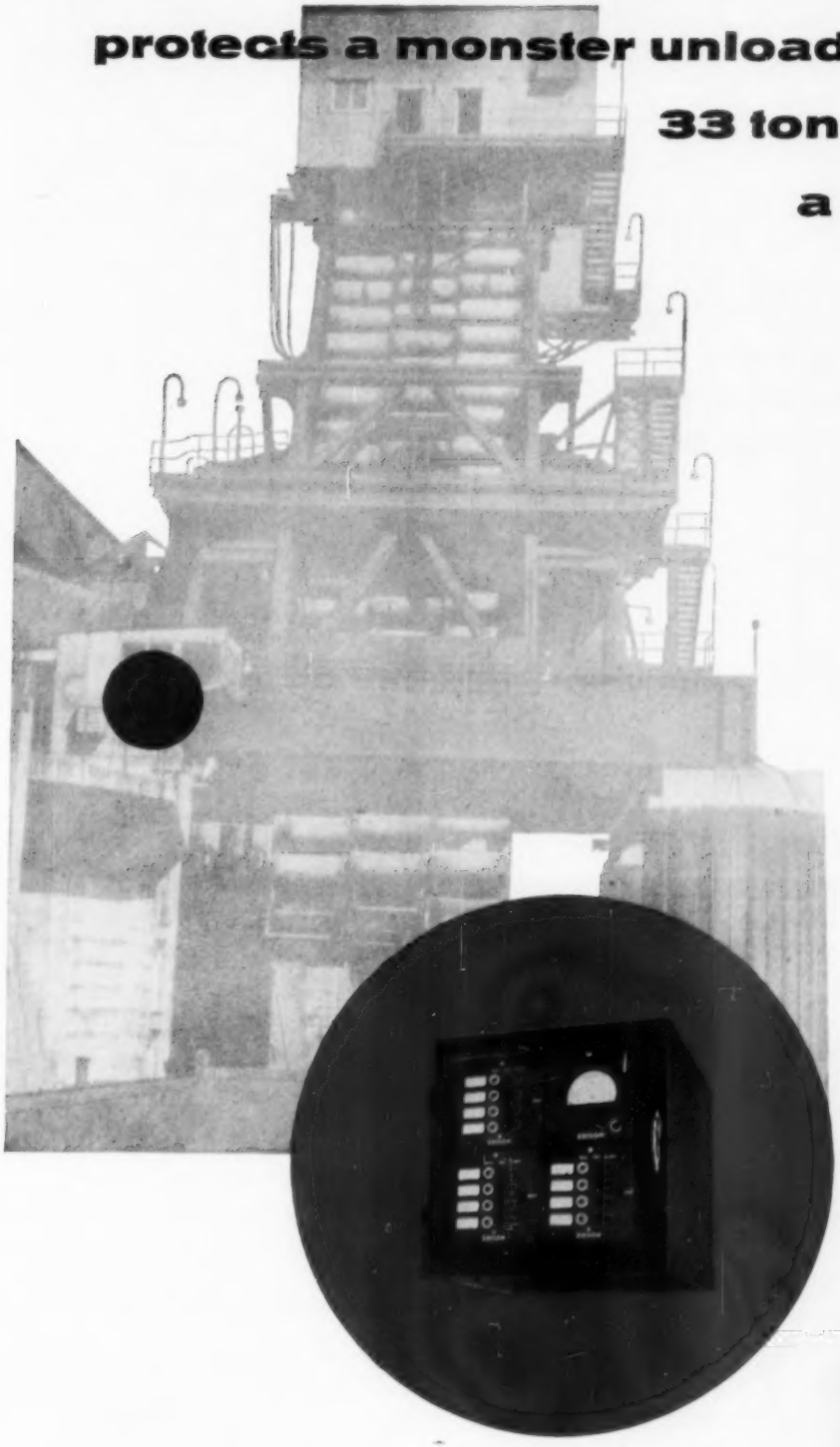
This is a book about methods of thinking; it attempts to formulate a series of what the author calls *approaches*, which are directed toward increasing our creative abilities. As Mr. Kogan points out, when one tries to learn a trade or puts to practical use something he has learned in school, his first attempts are usually clumsy. Gradually, he learns not only how to do things, but the best ways of doing them. He becomes less clumsy, more efficient, mainly because he develops, consciously or subconsciously, a *method* of doing things.

He acquires such methods either through instructions from others or from personally working out better ways of getting good results by trial-and-error. If he does enough thinking along original lines, he will develop a large store of ready methods (approaches) for many kinds of problems.

As many readers of POWER ENGINEERING know, Mr. Kogan is a successful consulting engineer who has solved a wide variety of difficult engineering problems throughout many years of practice. Through these years of effort, he believes that he has methodized

EDISON'S OMNIGUARD

protects a monster unloading 33 tons of coal a minute



System monitors drive-shaft bearing temperatures

The monster is a bucket elevator . . . it unloads 32,000 tons of raw coal in 16 hours. Minute after minute, it raises 33 tons 76 feet straight up . . . subjecting the entire structure to severe stresses, shocks, and vibrations. Installing a monitoring system was considered a tough instrumentation problem before Edison was consulted.

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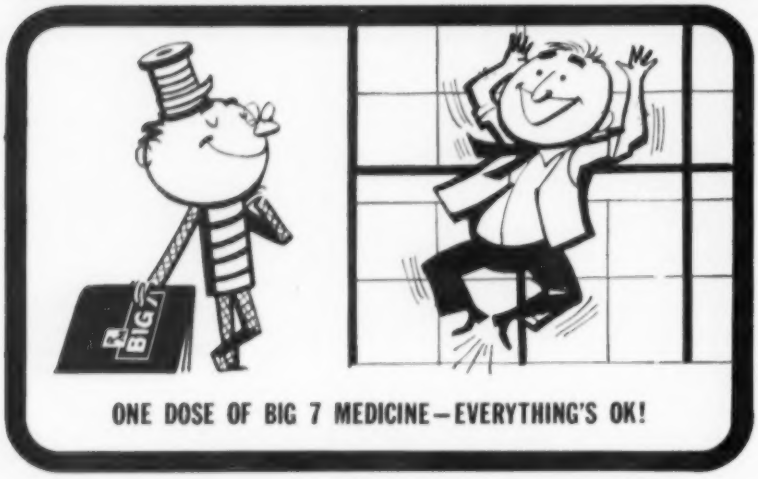

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Engineering Books

continued from page 96

this business of tackling problems to the point where it may be of value to others. And in this book he describes these methods in the hope that the reader will become aware of the use of these methods; and aware, also, of how these methods can lead us to the realization that there is no such thing as only one problem, and only one solution in a difficulty.

It is important to know that this book does not attempt to supply knowledge. For example it does not tell anyone who has never seen or operated a boiler how to solve a boiler problem, but it does help a person who is already familiar with boilers how to solve boiler problems more quickly. In other words it attempts to direct a person's knowledge so as to bring about more effective results.

In many ways this is an intriguing book because it analyzes certain things we do, or may have done, in such a way as to make our actions seem more logical. Often, we do not know just how we arrive at the solution of a problem. Mr. Kogan endeavors to show us that, unconsciously, we may have used methods in our thinking processes which may be of value to us in solving other problems in similar categories.

As Mr. Kogan points out in the preface to the first edition of his book, this volume is written for the practical man who must take the bull by the horns and produce results quickly and efficiently. Throughout, he has stressed plain, everyday language and included numerous examples to clarify his points.

* * *

Engineering Thermodynamics, by C. Osborn Mackey, William N. Barnard, and Frank O. Ellenwood. 444 pages, 6 by 9¼ in., cloth, 1957. Published by John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y. Price $7.95.

Although based on the widely used "Heat Power Engineering, Third Edition" by Barnard and Ellenwood, this is a completely new work covering the expanded boundaries of modern heat and power engineering. C. Osborn Mackey is the John Edson Sweet Professor of Engineering at Cornell University, and head of the department of thermal engineering.

Basic principles are set forth in the first six chapters. Later sections give extended treatment to such topics as one-dimensional flow of ideal gases with area change, friction and heat transfer, properties of mixtures of ideal gases, ideal gas reactions, energy transformations in turbines, power cycles with real fluids, refrigeration, and air conditioning. Throughout the book the author stresses the importance of applications of fundamentals.

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This cross-section of a typical Western Precipitation Electrical Precipitator shows a few of the many important details that go into the construction of these units...

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▶ Arrangement of curtains (1), baffles and hi-voltage wires (2) assures optimum uniformity of electrical field – therefore maximum collection efficiency.

▶ Baffles (3) insure minimum dust reentrainment and optimum gas distribution.

▶ Curtains and hi-voltage system are engineered for maximum stability, even distribution of rapper impact, and unequalled ease of installation.

▶ No moving parts in the gas stream.

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▶ Air-swept insulator compartments (6) insure long life, minimum maintenance.

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▶ Frequency and intensity of rapping is variable over wide ranges to eliminate puffing and meet individual operating requirements.

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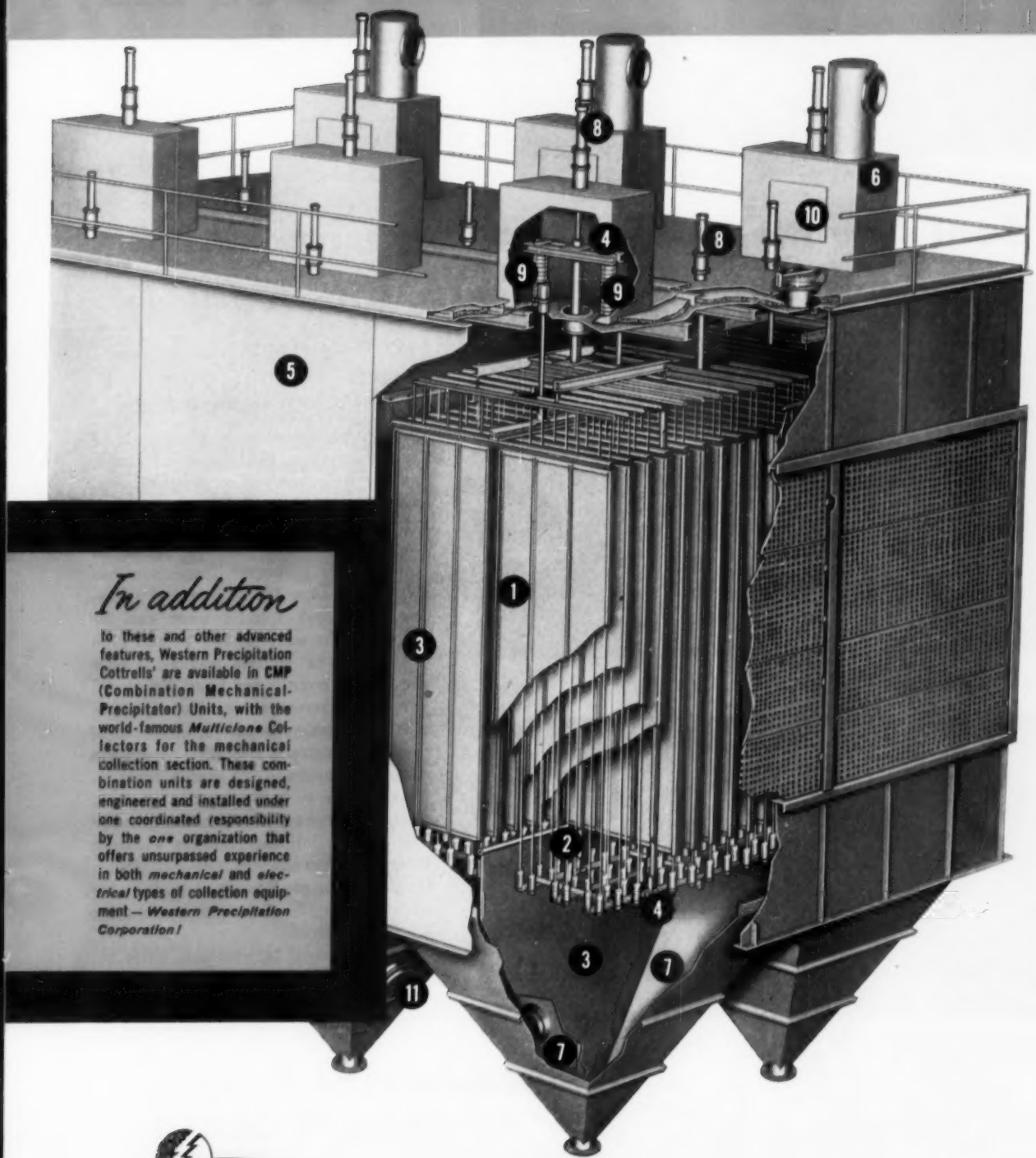

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to these and other advanced features, Western Precipitation Cottrells' are available in CMP (Combination Mechanical-Precipitator) Units, with the world-famous *Multiclone* Collectors for the mechanical collection section. These combination units are designed, engineered and installed under one coordinated responsibility by the *one* organization that offers unsurpassed experience in both *mechanical* and *electrical* types of collection equipment — ***Western Precipitation Corporation!***

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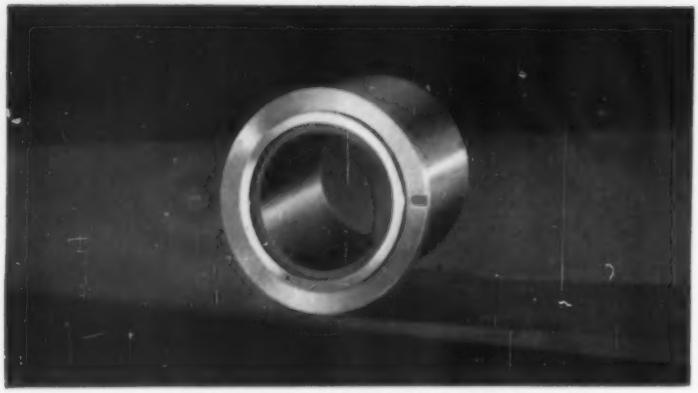

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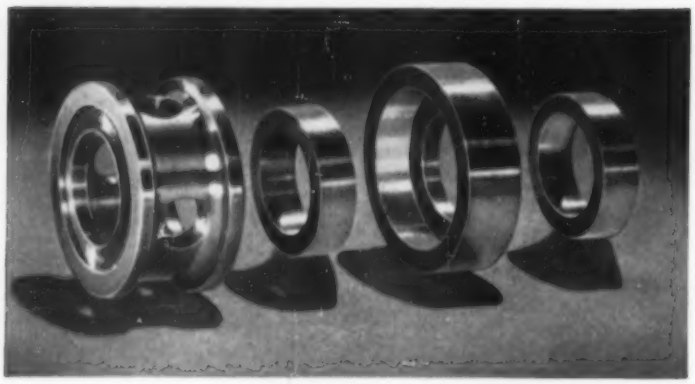

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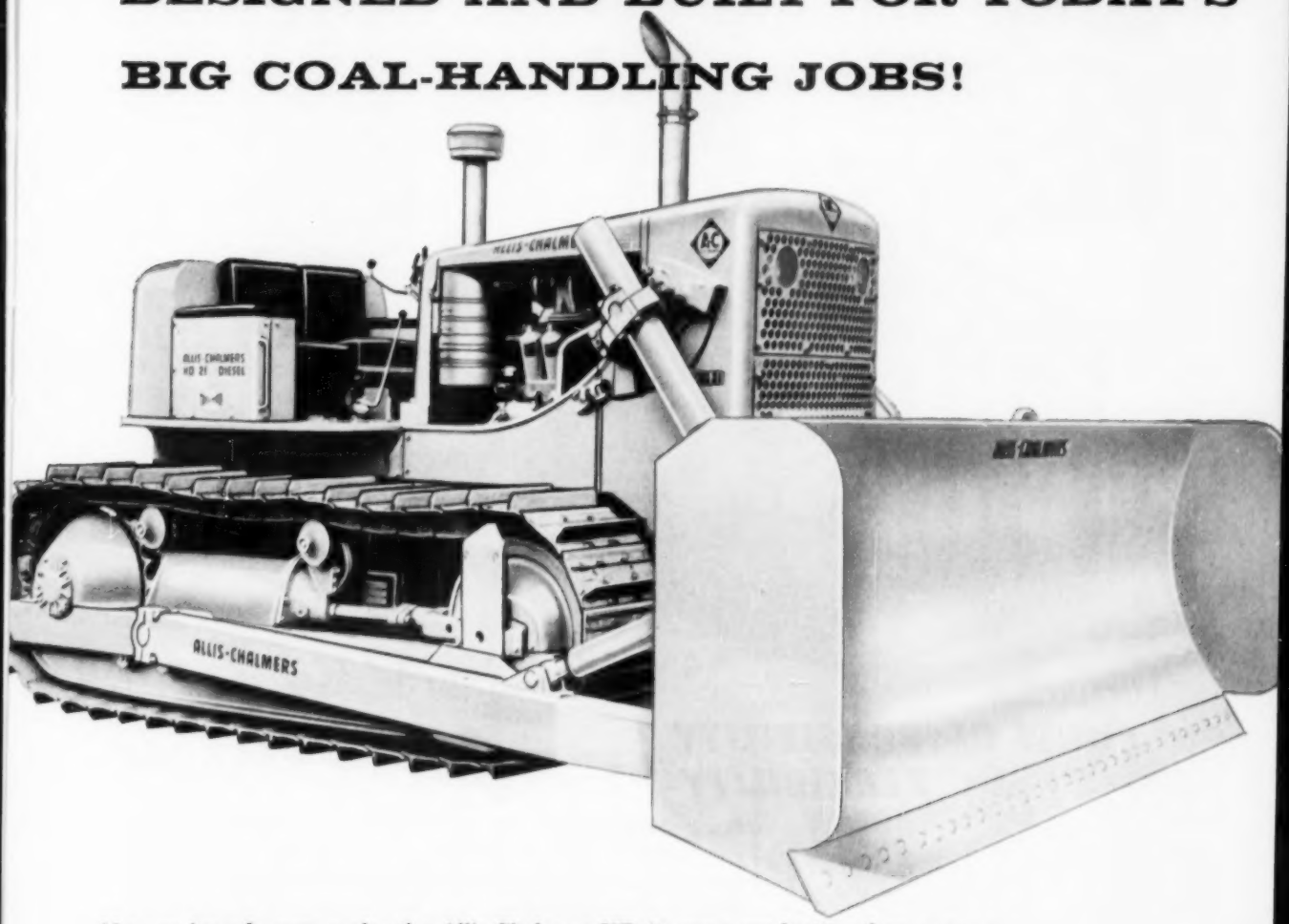

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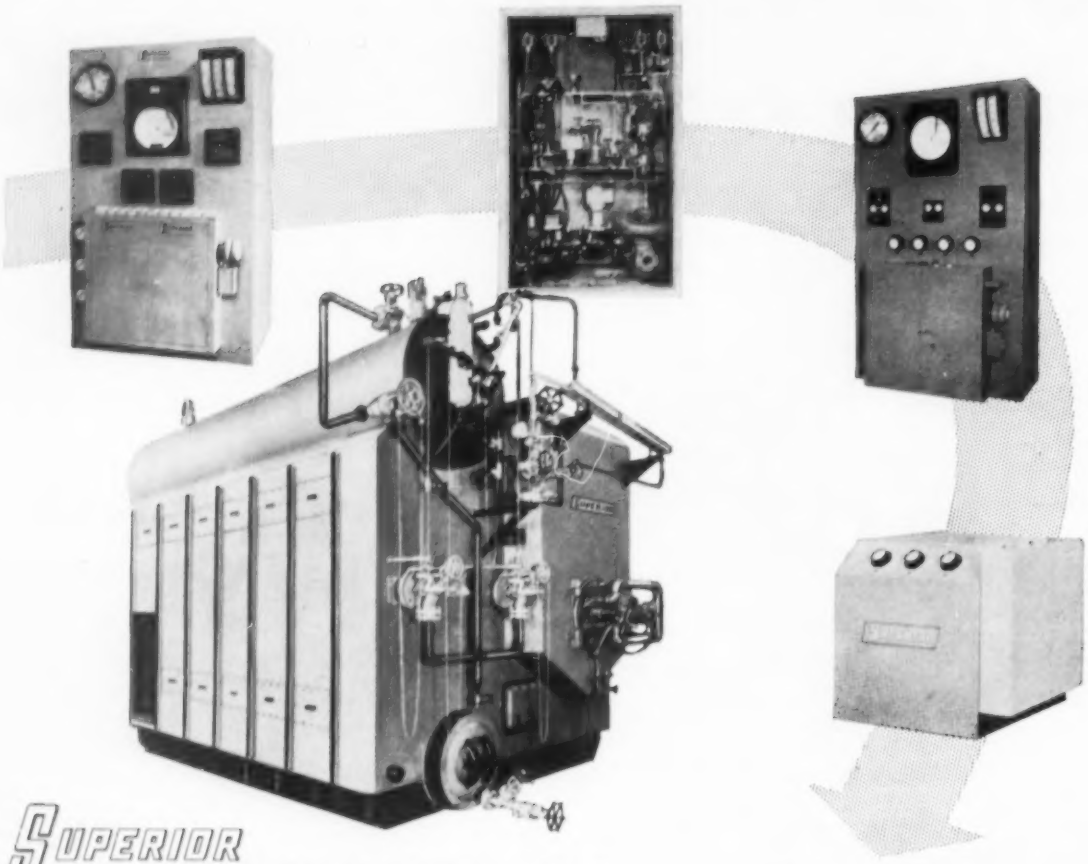

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201 Refractory Cement — Heavy duty brick bonding and patching mortar is described in this 8-pp illustrated color folder. Includes success stories concerning the product's application in high temperature work and in the protection of equipment against slag, fly ash and gases. Refractory and Insulation Corp.

202 Refractory Concrete — Basic information on recommended practice for mixing and placing refractory concrete, used in the metal, power, ceramic, and petroleum refining industry as a material to withstand service temp to 2600 F or more, is presented in this 16-pp manual. Sections are devoted to special properties of refractory concrete, aggregates, refractory insulating concrete, and structural design. Universal Atlas Cement Co.

203 Refractory Castable — Bulletin R-40 describes use of Kaocrete-32, a high temperature refractory castable, in boiler ashpits. A discussion of various methods of ash removal, along with maintenance problems peculiar to each, is presented. Four typical installations are detailed. Refractories Div., The Babcock & Wilcox Co.

204 Duct Insulation — Engineering data and application instructions for company's semi-rigid, spun mineral wool duct insulation are presented in this informative bulletin. Thermal and sound absorption characteristics are presented in tabular form and physical, chemical, mechanical properties given. Baldwin-Hill Co.

205 Underground Pipe Insulation — This illustrated bulletin discusses the problems of underground pipe insulation and explains how company's insulation for hot underground pipes overcomes them. On-the-job photos illustrate ease of application; brief technical data are also included. American Gilsonite Co.

206 Insulations, Refractories — This 20-pp catalog features thermal insulations and refractories for general industrial applications. Organized for quick reference, catalog provides information on composition, physical and thermal properties and sizes of the various products. Lists chief advantages, covers materials for efficient control of temperatures from −400 F to 3000 F. Johns-Manville.

BOILERS, GENERATORS

207 Water Tube Boilers — This 12-pp catalog describes packaged water tube boilers, in capacities from 8000 to 50,000 lb per hour. Interesting as well as informative, this booklet uses color and illustrations to amplify text. Gives complete data and dimensions for boilers designed for firing oil or gas or both. Superior Combustion Industries, Inc.

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Use this space to ask for tear sheets and other information. ....

208 **Shop Assembled Boiler** — Sixteen-pp Bulletin G-76 completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. The Babcock & Wilcox Co.

209 **Hot Water Boilers** — This 20-pp brochure describes and illustrates design, construction, advantages and economies of the C-E La Mont controlled circulation hot water boiler for supplying high pressure, high temperature water for heating systems and process applications. Combustion Engineering, Inc.

210 **Steam Generators** — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-type boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cutaway illustration shows design details, and gas travel. Erie City Iron Works.

211 **Improved Steam Generator** — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data and dimensions for the units. Preferred Utilities Mfg. Corp.

212 **Standard Generators** — Bulletin B-55-4 describes company's SC economy series of standard steam generators designed to reduce steam costs for industrial plants. Pre-engineered, standardized steam generators offered in nine sizes, with capacities of from 50,000 to 150,000 lb per hour are described, and schematic and cutaway drawings of design features are included. Foster Wheeler Corp.

213 **Packaged Generators** — Bulletin MH 3-54, 14-pp, gives detailed coverage to company's Type MH packaged water tube steam generators which are furnished for oil or gas firing or both, with automatic, semi-automatic, or manual controls. Included are: cutaway illustrations, installation photos, tube arrangement layouts, construction details, auxiliary equipment, dimensions. Union Iron Works.

FUEL BURNING EQUIPMENT

214 **Oil and Gas Burners** — Bulletin OB-53, 28 pp, gives principles of selection and application of oil or gas burners, or a combination of both for standard and wide capacity range operation, together with air registers and fuel oil heating and pumping sets. Conversion table shows approximate relationships between quantity of oil burned, boiler capacity and air required for combustion. The Engineer Co.

215 **For Burning Refuse Fuel** — This 8-pp bulletin describes refuse fuel burning equipment, including a pneumatic refuse fuel distributor which spreads refuse fuels such as bark, wood chips, and bagasse uniformly over the grate surface. Discusses construction features of various components. Riley Stoker Corp.

216 **Steam Atomizing Oil Burners** — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces where steam or compressed air

NOVEMBER, 1957

NOTE: Card void after February 28, 1958

POWER ENGINEERING

Please have the manufacturers send me without obligation information or bulletins indicated by the numbers circled below.

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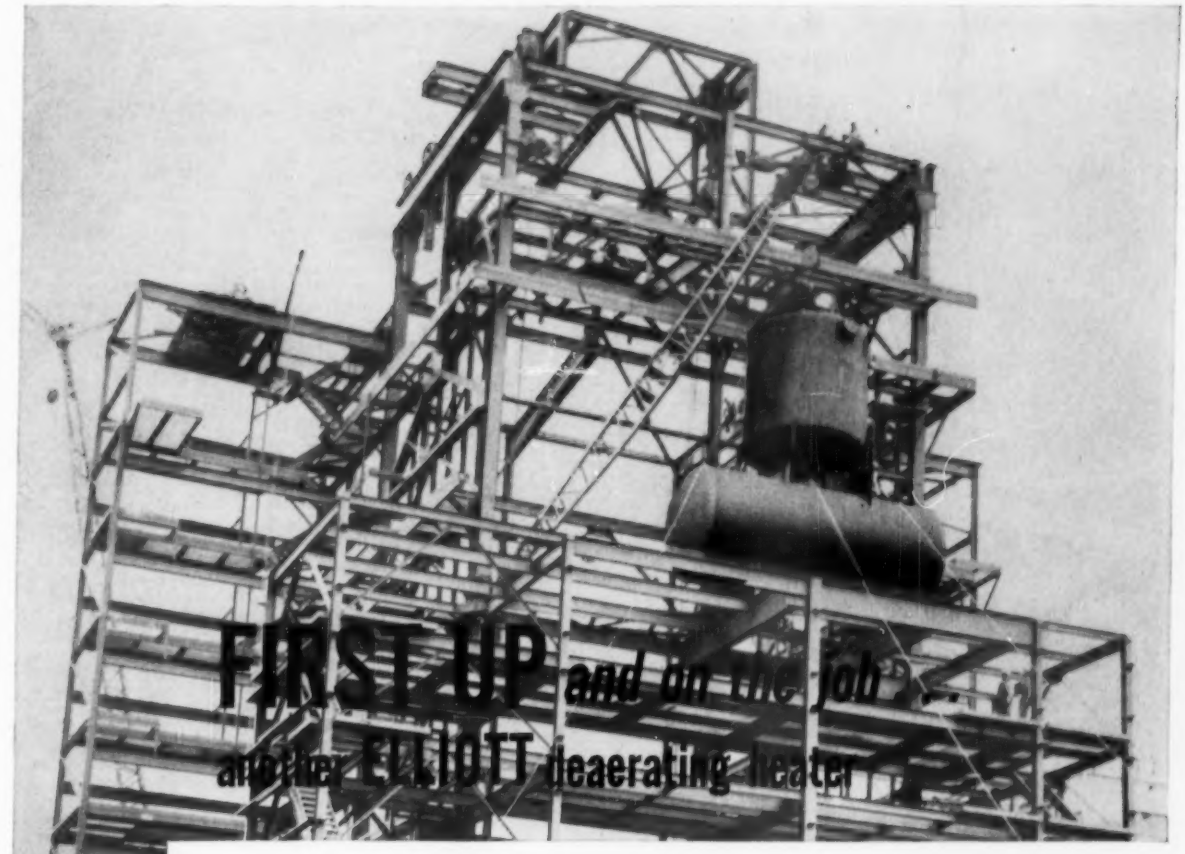


FIRST UP and on the job . . .
another ELLIOTT deaerating heater

to protect water and steam-handling equipment from corrosion!

Practically everytime a power plant goes up, another deaerating heater goes to work. In this new utility boilerhouse, an Elliott 800,000 lb-per-hr deaerating feedwater heater was hoisted up as soon as the steel framework was completed. Since then it has been operating day and night—protecting boiler tubes, piping, pumps and other equipment from corrosion by the removal of oxygen from the boiler feedwater.

Elliott has pioneered in the deaeration of water since 1918 and subsequently has built heaters from the smallest sizes up to units with a capacity of 2,500,000 lb per hr which serve power plants all over the country. In each case they were engineered to individual service requirements and space limitations. For complete details, write Elliott Company, Jeannette, Pa.

Cutaway section of small Elliott tray-type deaerating feedwater heater

ELLIOTT Company

H7-1

For more data circle 531 on Post Card

Visual of new boiler house which will soon supply power to The Ford Motor Division Lorain Assembly Plant, Ohio. A repeat order by Ford for Kuljian "turn-key" services.

INVESTMENT SECURE

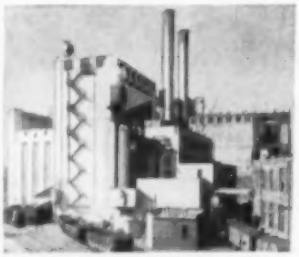
. . . engineering makes the difference!

Designing high performance qualities into utility and industrial power systems has been a Kuljian distinction for more than a quarter-century. Our power record —now listing one hundred major installations of from 500 to 300,000 KW capacity —represents a total capital investment of over half-a-billion dollars.

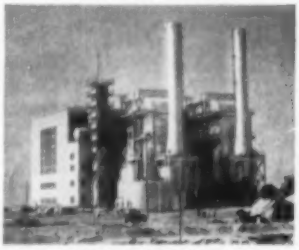
All of these projects bear ample evidence of Kuljian's basic aim: "design it better . . . build it better". From the earliest planning stage, through design, procurement, field management, and initial operation to final acceptance, the Kuljian system of top-level direction by recognized specialists offers the advantages of long-term savings . . . gives positive assurance that each project receives "Kuljian's best".

To secure *your* next investment, why not draw upon the wide experience of Kuljian to help with your problem?

CHAMOIS POWER PLANT
Chamois, Missouri



JOS. SCHLITZ BREWING COMPANY
Milwaukee, Wisconsin



TACOA POWER PLANT
Arrecifes, Venezuela, S.A.

DESIGN • CONSTRUCTION MANAGEMENT • SURVEYS • INVESTIGATIONS • REPORTS

The Kuljian Corporation

engineers • constructors

1200 North Broad Street • Philadelphia 21, Pennsylvania

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is available for atomizing the oil. Includes information on furnace design and construction. National Airoil Burner Co., Inc.

WATER CONDITIONING

217 pH and Chlorine Control — The 12th edition of company's handbook "Modern pH and Chlorine Control," 100-pp, incorporating theory and practice of colorimetric analysis, serves as a reference for quantitative determination of pH, chlorine, phosphate, nitrite, sulfate, hardness and other tests. Slide comparators and complete test kits are illustrated. In addition to standard pH determinations, methods are outlined for quantitative analyses of phosphate, calcium, magnesium, silica nitrate hardness. Available to qualified power engineers. W. A. Taylor Co.

218 For Boiler Protection — Scav-Ox, a 35 per cent hydrazine solution for removing dissolved oxygen from boiler feedwater, is described in this 16-pp illustrated booklet. It covers in detail the use of the solution for protecting low, medium and high pressure boilers, discussing determination of dosage, recommended methods of application, testing methods for hydrazine, and properties and handling of the material. Comprehensive operating data given. Olin Mathieson Chemical Corp.

219 Feedwater Treatment — Process Bulletin B1, "Treatment of Boiler Feedwater by Direct, or Internal Method," discusses advantages of direct treatment, as a complete treating program or as a supplement to external systems. Explains why direct treatment is convenient, economical. National Aluminate Corp.

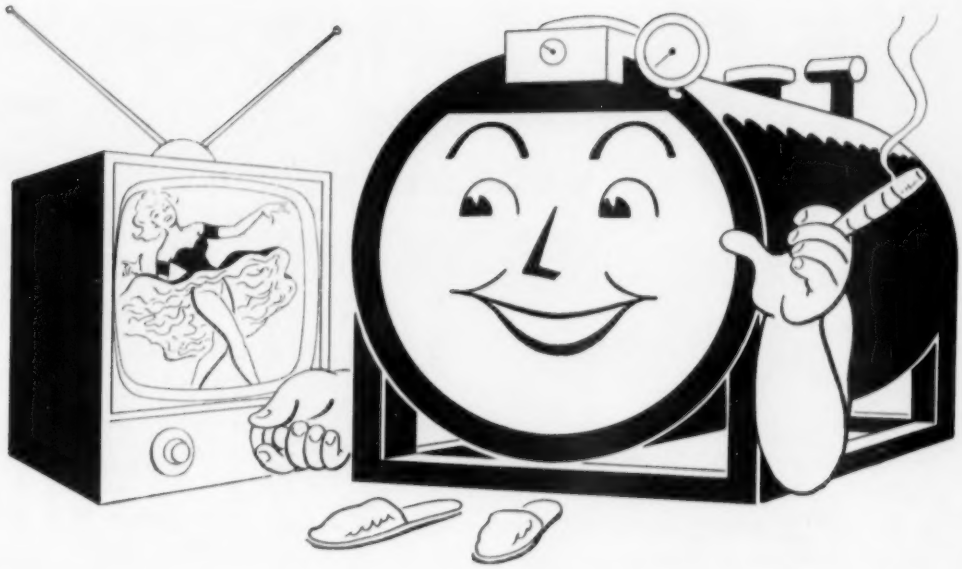
220 Feedwater Heaters — Open-Coil, tray-type feedwater heaters and purifiers of both deaerating and non-deaerating type are presented in 12-pp Bulletin 117-A. Construction and operational features of the heaters are explained and illustrated, and more than a dozen available models are pictured along with application suggestions. They cover capacities from 3000 to 300,000 lb per hour. Stickle Steam Specialties Co.

221 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

222 Feed Water Deoxygenation — The advantages of chemical deoxygenation of boiler feed water with an aqueous solution of hydrazine are described in 12-pp Bulletin BW 5. How hydrazine serves to maintain boiler in cleanest possible condition, reducing iron oxide scale to a magnetic oxide, is fully detailed, and such considerations as economy and operation, handling precautions, storage are covered. Fairmount Chemical Co., Inc.

223 Valveless Filter — Operation of company's automatic valveless filter is described in this 8-pp illustrated bulletin. Applications and typical operating conditions are detailed and diagrams and photos are included. The Permutit Co.

225 Data on Deaeration — This series of bulletins presents company's line of deaerating equipment for removal of dissolved gases from boiler feedwater etc. Publication 4651 describes Jet-Tray deaerators; No. 4652 covers tray-type units. No.



"Easy Living" with a Continental

Simplicity is the feature of the Continental Automatic Boiler.

Easy to install – a Continental Automatic Boiler is a completely integrated unit from one dependable source – not a collection of unrelated component parts expensively man-houred together.

Easy to specify – you can safely specify the minimum-sized boiler that will satisfy your requirements – Continental Automatic Boilers are guaranteed for more than 80% rated efficiency.

Simplicity of design – practical, two-pass design gives uniform flow of combustion gases through all return tubes. It's Continental's "Spinning Gas" technique where return tubes do equal work at equal temperatures – result, longer boiler life at more efficient, low-cost operation.

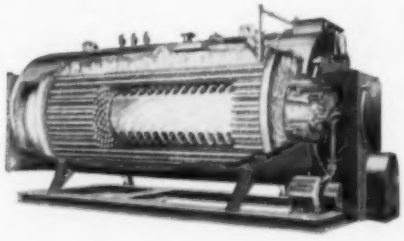
Easy to maintain – no baffles, no partitions – no take-out, put-back refractories. Hinged doors at front, back, and on the burner, make quick work of inspection and routine servicing.

Boiler-guessing stops when you order fire-tested Continental Automatic Boilers – for more details, write for Bulletin BE-3.

BOILER ENGINEERING & SUPPLY COMPANY, INC.

3 Manavon Street, Phoenixville, Pa.

The Continental AUTOMATIC BOILER



Cut-away view of typical Series A Continental Automatic Boiler, firing oil and/or gas. Other models from 20 to 500 hp, with on-off, low-high-low or modulating controls. For steam heating or process work at pressures from 15 to 250 pounds, or for hot water heating at low or high temperatures.

A HALF CENTURY OF BOILER MANUFACTURING EXPERIENCE

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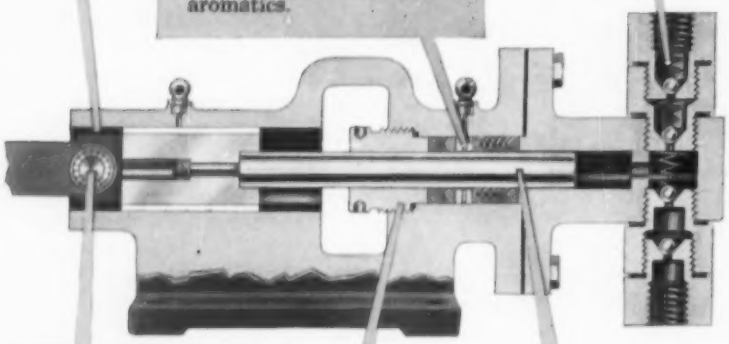
PICK THIS PUMP
for reliability and maintenance economy...

CROSS HEAD is oversized, running in carefully machined guide—preventing usual pump failures at this point. All moving parts and packing can be removed without breaking piping connections.

LIQUID ENDS: Valves are machined from solid stainless steel. No pressed seats to work loose. Valve balls are hardened and ground, and stainless steel spring-loading insures instant response, even on viscous liquids and slurries.

LANTERN RING readily changed from grease to water or oil seal for handling crystallizing liquids, slurries, corrosives, volatile toxics, aromatics.



CONNECTING ROD BEARINGS— hardened and ground pins running in grease lubricated needle bearings, replace the usual rapidly-wearing bronze bushings.

PISTONS are stainless steel, ground and polished. Accurate capacity control is obtained by piston stroke length adjustment. Adaptable to both manual control and instrumentation.

PACKING GLANDS are easily accessible at both ends to simplify packing replacement. Gland take-up is a screwed nut, insuring even pressure on packing—no cocking, less packing trouble.

For more facts about Philadelphia type S Pumps — for 85% of all chemical pumping needs — write for Bulletin S-1254.

PHILADELPHIA PUMP DIVISION OF AMERICAN METER COMPANY
13500 Philmont Ave., Phila. 16, Pa.

PHILADELPHIA PUMP

DIVISION OF AMERICAN METER COMPANY / EST. 1836

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4653 deals with cold water deaerators used primarily to reduce or eliminate corrosion of piping systems, heat exchangers. No. 4654 describes a surface-type deaerating hot water heater for commercial and institutional use. No. 4663 covers self-contained Uni-Pac deaerators for small and medium size power plants. No. 4635, 12 pp, on atomizing deaerators, details deaeration by atomization and its applications. Cochrane Corp.

226 Water Softeners — Twenty-pp Bulletin 1855-A describes this manufacturer's Accelator Hot-Flow softeners and Hot-Flow softeners of the slurry retention type covering advantages and applications of both. Describes and pictures reaction tank auxiliaries and associated equipment, and provides illustrations diagramming some typical installations. Sections of booklet are devoted to discussion of boiler feedwater treatment in general, limitations of hot process softening, and the chemistry of hot process treatment. Infilco Inc.

TUBING AND ACCESSORIES

228 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads. Roto Div., Elliott Co.

229 Heat Exchanger Tubing — Cited in this 30-pp catalog are typical cases where cupro-nickel or Monel tubing installed in heat exchangers resulted in substantial savings and better efficiency through longer tube life. Describes applications of this tubing in various instances where unusual water conditions, as to pollution, excessive turbulence, temperature and the like, required such tubing. The International Nickel Co, Inc.

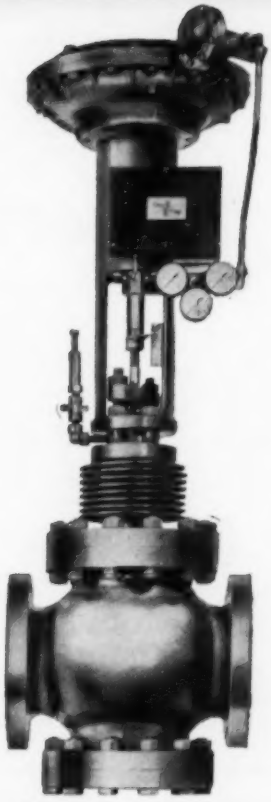
230 Tube Expanders — Catalog 88, 119-pp, is full of detailed information about tube expanders and associated tools used for tube rolling. Profusely illustrated, catalog provides information relative to boilers, condensers, evaporators or miscellaneous heat exchangers. Special sections are devoted to expanders, accessories, measuring instruments, rollers, extensions and drives. Each type of equipment is fully described, applications are listed, and tables of engineering data included. Also covers tube expansion methods, tool maintenance, expansion calculations and charts giving sizes. Thomas C. Wilson, Inc.

PUMPS AND PUMPING

231 Controlled Volume Pumps — Bulletin 953, 24 pp, describes and illustrates use of controlled volume pumps in industrial water treating systems. Construction and operation features are described, capacity-pressure ranges and speed and stroke length adjustments are charted. Typical chemical feed and water treating systems are presented through text and diagrams; and an analysis of boiler water treating systems, cooling water treating problems, and systems for waste and sanitary water treatment included. Milton Roy Co.

232 High Pressure Pumps — Eight-pp Catalog HP-1254 describes and illustrates company's Series HP controlled-capacity pumps for pressures to 35,000 psi and capacities to 2000 gph. Selection charts are provided for models with crank arm drive and yoke drive, along with application suggestions. Series HP pumps include some 298 models in three basic pump frame

C-V NEWS NOTES



New regulator valve delivers on more jobs

Designed for remote control service, the Copes-Vulcan diaphragm actuated valve handles water, steam, air, gas, oil and other similar fluids with new efficiency. This valve has been engineered and precision-built for those operations requiring superior accuracy and sure dependability.

The Type-CV-D Valve may be direct or reverse acting. It has excellent rangeability and serves a broad variety of applications in sizes up to 12 inch.

Optional features include: cooling fins and stuffing-box lubricator to maintain low friction over longer packing life . . . auto-lock . . . top or side-mounted hand wheel for emergency operation.

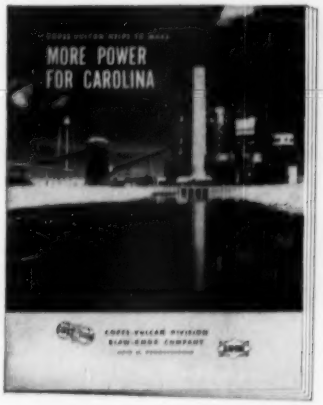
To assure trouble-free performance, Copes-Vulcan custom-designs each valve to suit your most exact control requirements. Write for Bulletin 1027.

Desuperheater developed to increase control

Based on a new steam-assist principle, this Copes-Vulcan Desuperheater permits close control of final steam temperature for processing work or auxiliaries. Using assisting steam only on lighter loads, it decreases the amount as the load increases. Exclusive swirl-chamber intimately mixes cooling water with steam. In-line type also available. Write for Bulletin 1024.

On-the-job report on boiler control

How Copes-Vulcan helps make more power for Carolina Power and Light Company is covered in this factual report on the Louis V. Sutton plant. Highlights include: Combustion, feed water, boiler feed pump re-circulation controls plus automatic-sequential soot blowing. Write for Bulletin 1032.



COPES-VULCAN DIVISION
BLAW-KNOX COMPANY
ERIE 4, PENNSYLVANIA

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sizes for 2-, 3-, and 4-in. pump strokes. Specifications, design features discussed. Philadelphia Pump & Machinery Co.

233 Flow Control — Twelve-pp Catalog 800 describes four basic models of precision proportioning pumps for uses requiring accurate and positive proportioning of flow in range of 0 to 750 gph. Materials of construction, capacities and pressures are shown for each. Diaphragm valves are discussed and their features noted. A section on plastic valves and diaphragms features those for temperatures to 300 F, and includes diaphragm material chart covering selection for use with air, water, corrosives, slurries, liquids, gases. Hills-McCanna Co.

PACKINGS, SEALS

234 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing applications. Packing Div., Raybestos-Manhattan, Inc.

235 Mechanical Packings — Featured in 24-pp Catalog 56 are several recent packing developments including the multi-purpose Bel-Vee V-Ring packings, the long wearing criss-cross Braid packing series, twisted foil packings for oil and distillate temperatures to 1000 F, and an Inconel-wire reinforced plastic packing for valves handling superheated steam at temperatures up to 800 C. Packings for every industrial application are covered and a recommendation chart is included. The Belmont Packing & Rubber Co.

236 Mechanical Seals — Bulletin S-205-2, 8-pp, covers the complete line of chemically inert mechanical seals for handling all types acids, corrosives, solvents and gases. Provides construction, service and application information, installations and engineering details. Crane Packing Co.

McCORD Class "WT" CHEMICAL FEEDER

The Motor Driven "WT" Chemical Feeder illustrated can be furnished complete with motor, suitable speed reducer, tank of 15 gallon capacity and 1/30 HP motor driven agitator. It is furnished with a suitable drive reduction and 3 step variable speed pulleys and stroke adjustment for rapidly varying the capacity. Pump unit, tank assembly and agitator can be furnished separately or in combination and also with meter proportioning controls.

OUTSTANDING FEATURES OF McCORD WT CHEMICAL FEEDER

1. New improved type valve mechanism. Highly efficient for handling light bodied fluids. Works equally well with heavy fluids or slurries and does not become clogged by foreign particles carried into the pump.
2. New improved type packing with large stuffing box reduces necessity of frequent adjustment.
3. FLUID SEAL—at stuffing box to counteract possible crystallization of chemical around plunger. Also arranged for continuous flooding of exterior of stuffing box to avoid plunger build-up when handling hot phosphates, silicates or lime slurries.
4. Readily accessible removable valves and seats.
5. Removable pump units. Cast iron body with stainless steel plunger and valves is standard. Also available in stainless castings, lucite trim or all steel.
6. Rapid feed adjustment through wide range while pump is in operation.
7. All wearing parts made from steel forgings and operate in a bath of oil.

Write for complete catalog.

LUBRICATOR DIVISION
McCORD CORPORATION
Detroit 11, Michigan

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VALVES, TRAPS, PIPING AND ACCESSORIES

237 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principles of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

238 Water Hammer Control — Cause, effect and control of water hammer in piping systems is the subject of 8-pp Bulletin WH 851. Photos, drawings and curves supplement text, and test data is presented to show efficiency of company's silent check valves in water hammer control. Some typical installations are illustrated. The Williams Gauge Co., Inc..

239 Boiler Blow Off Valves — Bulletin E-125, 24 pp, describes and illustrates the design and construction of company's quick-operating valves, angle valves, Y valves and duplex units specifically designed for boiler blow-off service. Includes dimensions. Everlasting Valve Co.

Do any of these catalogs answer your operating or maintenance needs? Let us know by circling the number of the catalog on the post card provided on pages 105–106. We'll do the rest!

240 Lubricated Plug Valves — Catalog PV-24, 36-pp, shows in detail a line of iron and steel lubricated plug valves. Many illustrations of the single, screwed and bolted gland type valves are shown, including photos, sectional and detailed drawings. Also included is physical data on dimensions. The Wm. Powell Co.

241 Valve Chart — Form 194R, 22 pp, is a valve comparison chart, listing valve figure numbers of 15 major manufacturers and the OIC equivalent valve figure numbers. Compares variety of valves in ferrous and non-ferrous materials, describes different valve lines. The Ohio Injector Co.

242 Choosing the Right Valve — Presenting valve selection as a matter of matching the valve's service characteristics with service requirements of the job, this practical 20-pp booklet explains and illustrates basic design features of gate, globe and check valves. It tells, in non-technical language, how each of these valve

types works, and where it is suited for use. Disc, stem connection, bonnet and bonnet-joint characteristics are discussed and illustrated. Crane Co.

243 Valve Data — This loose-leaf notebook contains a collection of company's bulletins on its line of valves for control of air, gas, liquids and solids. It features complete operating, design, dimensional and specification data on butterfly, slide, automatic and proportioning valves, and is profusely illustrated with photos, drawings and diagrams, highlighting valve design and construction. W. S. Rockwell Co.

244 Trap Service Guide — To promote better trapping practice, pocket-size 32-pp Bulletin 7511 offers practical tips on installation, testing, and maintenance. Chapters are devoted to inspection and repair, trouble shooting, parts identification. Capacity charts are provided, also tables showing interchangeability of company's trap parts. Other sections deal with strainers, check valves, automatic trap drains. Armstrong Machine Works.

245 Steam Trap Selector — Twelve pp Bulletin T-9 is designed specifically to aid in selection and application of steam traps on chemical processing equipment. Features a foldout piping diagram for 22 pieces of typical processing equipment — each showing recommended steam trap and piping arrangements. Also contains selector tables. Yarnall-Waring Co.

246 To Get at Those Valves — This little folder describes a sprocker rim with chain guide. The rim adjusts to fit all valve wheels. Babbit, Steam Specialty Co.

LUBRICATION

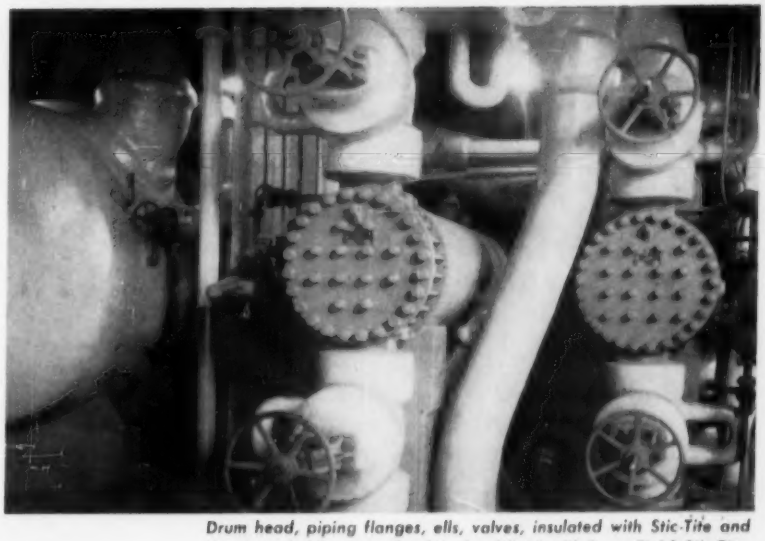
248 Multi-Purpose Grease — This bulletin describes Gargoyle Grease BRB No. 1, intended to provide correct lubrication for practically all normally loaded anti-friction and plain bearings. Tells how it resists leakage, affords protection. Socony Mobil Oil Co., Inc.

249 Lithium Soap Greases — This product information bulletin details qualities and specifications of company's multi-purpose soap industrial greases. Advantages of multi-purpose grease use — such as prevention of lubricant misapplication, simplified maintenance procedures are discussed. Sinclair Refining Co.

MECHANICAL POWER TRANSMISSION

250 V-S Drive Selection Tips — Bulletin 20P50, 44 pp, carries handy multi-color tables for quick and easy selection of variable speed Texrope drives. In addition to providing these tables for A, B, C and D section variable speed drives, booklet includes information on design features, drive principles, horsepower rating tables, speed range table. Allis-Chalmers Mfg. Co.

251 Internally Geared Power — Featuring latest design improvements in gearmotors and embodying 60 multicolor illustrations, 16-pp Form F-1880 shows comparative advantages of gearmotors, lists ratings from ½ to 30 hp with gear ratios as high as 10:1. Cross-sectional details and enlargements of outstanding features are included, as well as a discussion of use of elliptoidal helical gears, and a chart graphing degrees of tempering of gear teeth. U. S. Electrical Motors Inc.



Drum head, piping flanges, ells, valves, insulated with Stic-Tite and then troweled to a smooth, white, hard finish with Super Finish Stic-Tite.

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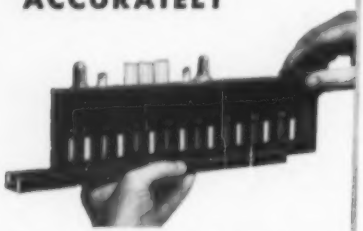
TAYLOR COMPARATORS

HELP YOU ADJUST

pH, PHOSPHATE LEVELS

QUICKLY, ACCURATELY



By making fast, on-the-spot determinations for pH, phosphate, nitrate or silica with handy, portable Taylor Comparators, you can easily maintain proper control of boiler, condenser or cooling tower operations. In a matter of minutes you get accurate, dependable data from easy, colorimetric tests. Only three simple steps . . . fill three tubes with sample, add reagent to center tube and read result direct from slide after matching colors. Complete instructions, all necessary accessories and reagents included in every set.

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SEE YOUR DEALER for Taylor sets or immediate replacement of supplies. Write direct for FREE HANDBOOK, "Modern pH and Chlorine Control". Gives theory and application of pH control. Illustrates and describes full Taylor line.

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410 RODGERS FORGE RD. • BALTIMORE 4, MD.

252 Fluid Drives — Bulletins 9419 and 9519 are an illustrated catalog and selection guide on company's new Type VS Class 2 Gyrol fluid drives. Catalog discusses advantages and applications of the drives, covering speed control, power savings, simplified installation, etc. A sectional view shows construction and principle of operation. Dimensions for six sizes of drives are provided. Selection guide consists of tables indicating proper drive to use. American Blower Corp.

INSTRUMENTS, CONTROLS

253 Boiler Feed Control — Bulletin 1003, a 12-pp catalog on boiler feed regulators, is illustrated with large application photos and detailed schematic drawings and charts. Relay and direct operation are covered. Case studies of representative boiler loads are presented to show stability of the Flowmatics in controlling feedwater. Copes-Vulcan Div., Blaw-Knox Co.

254 Meters and Controls — Over 100 measuring, transmitting, receiving, recording and indicating instruments and control components, including those introduced within the last year are described in the 8-pp 1957 edition of company's Bulletin G15-1. Applications, ranges, and detailed literature references are given for each product. Bailey Meter Co.

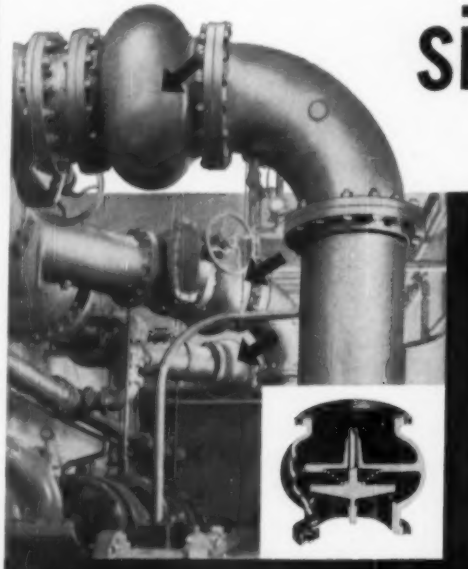
255 Instruments, Controls — Condensed Catalog 1537 offers brief application information on manufacturer's line of instruments. Fully illustrated, covers draft and pressure instruments, flow meters, liquid levels and pressure gages CO_2 meters, pneumatic transmitters, positioning operators, temperature instruments, boiler feedwater controls, others. Includes references to detailed literature on each type of equipment. Republic Flow Meters Co.

256 Indicating Flow Meter — Bulletin 18-A, 22-pp, discusses advantages, construction and operation of company's Type H indicating flow meter. Presents technical data on the principles and theory of fluid measurement and discusses orifice type meters and orifice meter principles. Offers examples of flow rate calculations. Schematic drawings and diagrams, tabulated technical data and specifications are included. The Meriam Instrument Co.

257 Guide to Gages — Catalog 300-B, 112 pp, features Ashcroft Duragauges, Maxisafe, pneumatic receiver, recording, quality, drawn casem chemical and special application gages. Also presented are gauge testers, pneumatic transmitters, gages for nuclear energy. Engineering data and charts are provided. Instruments shown cover dial sizes from 2 through 24 in., pressures from 30 in. vacuum or a few ounces up to 100,000 psi. Manning, Maxwell & Moore, Inc.

258 Resistance Temperature Detectors — In 8-pp Publication 3016D are described a line of remote temperature-sensitive elements for use in indicating, recording, controlling and monitoring equipment. Operation, application and construction details of the resistance temperature detectors are presented, along with specifications and ordering tips. Instrument Div., Thomas A. Edison, Inc.

259 Cooling Controls — Bulletin 710B describes company's self-powered cooling controls for compressors, stills, solvent coolers, degreasers, oil coolers,



silent system

Piping systems in every industry have been made free from troublesome water hammer . . . free from dangerous surge pressures. *Silent* Check Valves eliminate these hazards by operating instantly when flow reversal starts or when flow is zero. *Write for descriptive Bulletins.*

Globe type for 3" to 24" lines.

Center-guided type for lines from 1" to 10".

WILLIAMS-HAGER Silent CHECK VALVES

Write for Bulletins No. 654 on the Valves; No. 851 on Cause, Effect and Control of Water Hammer

THE WILLIAMS GAUGE CO., INC.
143 STANWIX STREET
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Our 71st Year — 1886-1957

small engines, condensers, others. Includes operational drawing and hook-up sketches. Sarco Co., Inc.

CORROSION CONTROL

260 Corrosion Control — Treatment of industrial equipment to control corrosion cannot be a hit-and-miss proposition cautions this 6-pp folder. Examples are given of optimum control measures that may avoid costly, unsound treatment procedures, including minor physical or operating changes. Hall Laboratories, Inc.

261 Corrosion, Abrasion Control — Modern practices and products for the positive protection of metal equipment from the effects of corrosion and abrasion are described in this 16-pp bulletin. Covers factory and field application of rubber or synthetic linings to metal parts or products, and maintenance coatings available for application by plant personnel. Goodall Rubber Co.

262 Guide to Corrosion Prevention — How Bitumastic protective coatings aid in fight against corrosion is told in this 12-pp booklet. Discusses corrosion as a universal industrial problem, role of protective coatings in cutting costs and lengthening service life of structures and equipment, and gives data on several coal tar-based coatings intended to solve a variety of corrosion problems. Twelve typical case histories covering use of these coatings in varied industries described. Koppers Co., Inc.

ELECTRICAL EQUIPMENT

263 Testing Instruments — Bulletin 19-57, 16 pp, features company's electrical testing instruments, including ohmmeters, ground testers, dielectric test sets, motor rotation tester, cable fault locating equipment, transformer turn ratio test sets, corona test equipment, frequency meters, tachometers, others. Includes photos and descriptions of each type, including chief features, operating ranges, and applications. James G. Biddle Co.

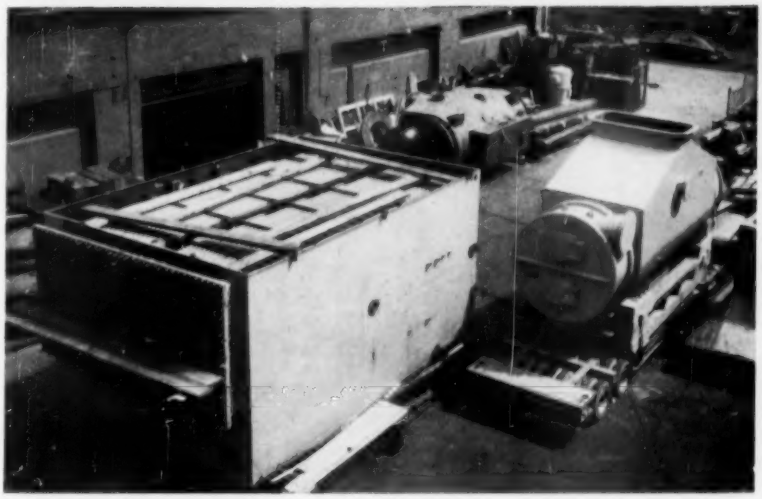
264 On Copper Conductors — Publication C-25, 62 pp, is designed to help make the selection of bus conductors easier. Included in booklet are tables regarding such shapes as channels, ventilated square tubes and round tubes. There are tables for other rigid bus conductor shapes, also data on bare copper wire and cable as well as commonly used alloy wires. Also provided is a general discussion of copper, its physical and electrical properties. Photos illustrate many installations. The American Brass Co.

265 Selecting Protective Devices — The Protection Handbook, 24 pp, is based on the 1956 National Electrical Code, and interprets this code into easily read form. It covers the selection of protective devices for electric circuits, motors, appliances and apparatus, and includes a list showing the size to use when ordinary fuse, Fustron dual-element fuse or Fustat is installed. All information is condensed. Fully illustrated, book gives wiring diagrams, motor tables. Bussmann Mfg. Co.

OTHER EQUIPMENT

266 Product Guide — Manufacturing facilities for company's line of steam turbines, turbine generators, ship propulsion units, feed pumps, centrifugal com-

Choice of Experience..
CONSECO CONDENSERS



- CITY OF DETROIT, MICHIGAN
  One 27,500 sq. ft. condenser
- CITY OF WASHINGTON, INDIANA
  Two 8,500 sq. ft. condensers

This recent photo taken at our shop shows one of the City of Washington units being shipped, the other being fabricated —and the City of Detroit condenser being assembled.

These are small units, compared to many CONSECO has supplied, such as three of 70,000 sq. ft. each for the City of Los Angeles, Cal. . . . one 45,000 plus two 20,000 sq. ft. units for Puerto Rico . . . four 12,000 sq. ft. units and one 35,000 sq. ft. unit for Dairyland Power Cooperative . . . to mention just a few of scores of installations.

Big or small, CONSECO Equipment is the choice of Engineers who have well-placed confidence in CONSECO'S 30 years' experienced engineering, sound design, dependable manufacturing and better performance.

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For more data consult Chemical Engineering Catalog pages 559–562.

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HEAT EXCHANGERS • CONDENSERS • EVAPORATORS • STEAM JET AIR EJECTORS • PRESSURE VESSELS • FEED WATER HEATERS • SEWAGE EJECTORS • CONDENSATE COOLERS • ENGINE PARTS • SERVICE WATER COOLERS • FILTERS and STRAINERS • INSTRUMENTS • SPECIALTY ITEMS

COMPLETE BULLETINS SENT ON REQUEST

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This AIR-COOLED CONDENSER *produces a* HIGHER VACUUM

AT THE
CHEMICAL SHOW
26th EXPOSITION OF CHEMICAL INDUSTRIES
Coliseum, New York City, December 2 – 6, 1957
See NIAGARA
AIR CONDITIONERS • *Aero* HEAT EXCHANGERS
Aero AFTER COOLERS • *Aero* REFRIGERANT CONDENSERS • *Aero* STEAM CONDENSERS
Aero VAPOR CONDENSERS • HUMIDIFIERS
HEATERS • COOLERS • DRYERS
BOOTH No. 655

● Using air as the cooling medium, the Niagara *Aero* Vapor Condenser produces a higher vacuum than other type condensers, and with more economy of power and steam.

It sustains its full capacity in cooling or condensing with no more than a nominal cooling water requirement, eliminating entirely your problems of water supply and disposal.

It holds constant the liquid or vapor temperature producing always uniform products and giving maximum production.

Non-condensibles are effectively separated at the condensate outlet, with sub-cooling, after separation for higher vacuum pump efficiency.

Niagara *Aero* Vapor Condenser can be mounted directly on the steel structure of your evaporator or distillation column. Its operation is dependable; its maintenance is not troublesome or expensive.

For more information write for Bulletin 129K

NIAGARA BLOWER COMPANY
Over 55 years of Service in Industrial Air Engineering
Dept. E-11, 405 Lexington Avenue
NEW YORK 17, N. Y.
District Engineers in Principal Cities of U. S. and Canada

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267 Precipitation Products — Twelve-pp Bulletin G406 contains helpful information on company's various precipitation products, including electrical precipitators, multiclone mechanical dust collectors, combination multiclone-precipitator units, Dualaire filter-type dust collectors and Holo-Flite processors. Also illustrates a number of typical installations. Western Precipitation Corp.

268 Preheating Combustion Air — This well-illustrated 36-pp booklet explains fuel savings and increased performance made possible by using waste heat in flue gases to preheat incoming combustion air. Also covers increased boiler output, ability to use lower grade fuels, other advantages afforded. Booklet contrasts regenerative with recuperative preheaters; explains operating principle and structural details of the Ljungstrom air preheater. Applications for other than power boilers are also covered. Air Preheater Corp.

269 Sectional Condenser — Bulletin 131 shows benefits of sectional-design refrigeration condensers for 100 to 240 tons refrigeration capacity and explains their functions with diagrams and installation photos. A cutaway shows component parts. Niagara Blower Co.

270 Water-Cooled Stoker — Design and operating advantages of the Vibragrate Stoker are outlined in this illustrated bulletin. A large cutaway view details component parts of the stoker and explains operating features. Other drawings show installations. American Engineering Co.

272 Refrigeration Condensers— Engineering data on a complete range of sizes and types of refrigeration condensers are featured in 38-pp Bulletiu RC-2. Ratings in tons refrigeration are tabulated for large and small ammonia condensers, vertical ammonia condensers, ammonia condenser-towers, freon condensers and freon condenser-towers. Selection data, dimensions, dimensional diagrams and tables of pipe sizes given. Henry Vogt Machine Co.

273 Ejector Data — This 12-pp bulletin presents company's steam jet air ejectors designed for efficient, low cost air removal from condensers. Illustrates basic ejector assembly, and discusses principle of operation. Single- and multi-stage units are shown. Also described are steam jets for special services and air ejector accessories. Engineering data pertinent to ejector application in power plants, process plants and evaporators included. Condenser Service and Engineering Co., Inc.

274 Tractor Shovel — This 8-pp bulletin deals with construction and application of company's HD-11G tractor shovel, a 2¼-yd capacity unit with several work-speeding features. Transmission, hydraulic system, shovel assembly and other components are described in detail. Specifications included. Allis-Chalmers Mfg. Co.

275 Steam Turbines — The advantages of company's solid wheel turbines, axial flow turbines, single stage and multi-stage, are outlined in illustrated Bulletin S-140. Describes various models in their line and includes application photos. The Terry Steam Turbine Co.

Stop Corrosion
in boilers, steam and return lines . . .
with this Stickle deaerating feed water heater

SAVES STEAM
Vent Condenser releases only air and contaminated gases to atmosphere
NO CONTAMINATION
Counterflow of steam and water prevents reabsorption of oxygen
SELF-CLEANING
There is no need for removable baffles or trays

Stickle Baffle Spray Type Deaerating Feed Water Heaters stop corrosion by removing destructive oxygen and carbon dioxide from boiler feed water . . . reduce fuel costs and boiler strain. Vertical and horizontal models. Capacity range: 3,000 to 300,000 pounds per hour. The latest development in more than 50 years of building feed water heaters.

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S-217 . . . Baffle Spray Type Deaerating Feed Water Heaters
117 . . . Open Coil Feed Water Heaters

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Stickle Equipment
Cuts the cost of steam

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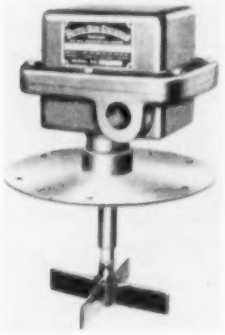
continued from page 48

29—LEVEL CONTROL designed for more rugged service

Engineering changes in the Roto-Bin-Dicator are said to permit use of this equipment where severe, or rugged operating conditions exist, such as vibration and high stresses on paddle and shaft assembly. Available in standard and explosion-proof models, this bulk material level control device is suggested for use in bins under pressure or vacuum; bins, chutes or conveyors handling lumpy materials which tend to "bridge" over a diaphragm; and bins holding materials which tend to "rat-hole". To



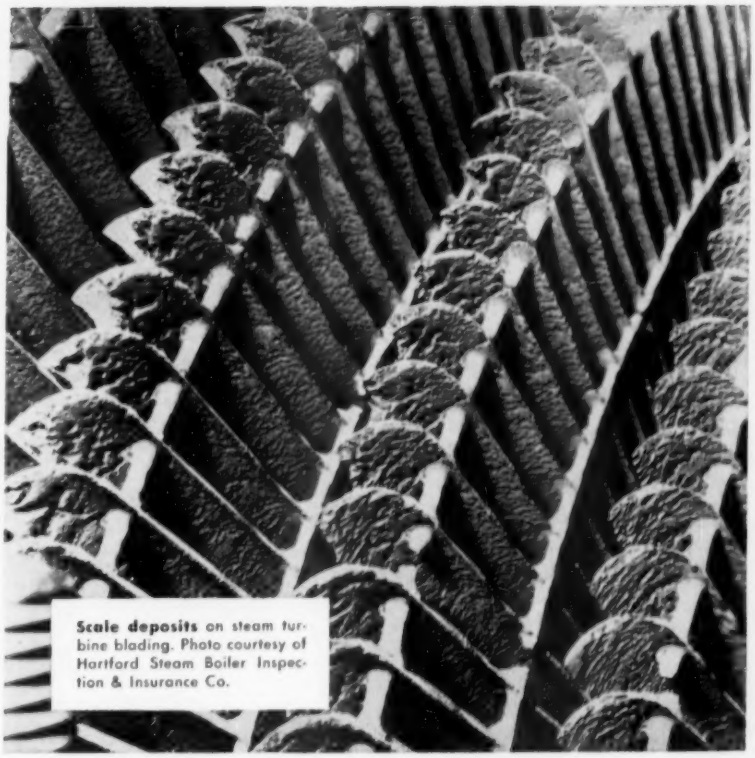
circumvent these problems, the Roto-Bin-Dicator has a slowly rotating paddle, mounted on a flexible shaft. This projects into the bin and is driven by a small motor in a housing outside bin.

When material in the bin covers the paddle its rotation is stopped and the torque exerted by the motor actuates a Micro-Switch in the motor housing. When material drops below the paddle, rotation is resumed and the switch returns to normal position. The shaft flexes as required under impact or thrust of material and does not take on permanent distortion, manufacturer explains, and being flexible it sheds top loads. The improved Roto-Bin-Dicator has a re-designed low torque motor and gear reduction unit, as well as an improved mounting arrangement. Bulletin 8C gives details. Bin-Dicator Co.

Reader Service Cards on pages 105–106 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

30—LOW PRESSURE SWITCH is economical, sensitive

This switch is introduced as an economically-priced, low pressure switch to control or signal small pressures, vacuums or differential pressures. It is suggested for control of movement of roll-type air filters, pressure regulation of gas boosters, switch operation of dampers, blowers, gas-fired heaters and

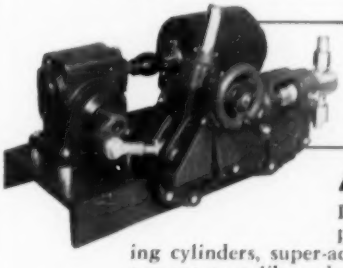


Scale deposits on steam turbine blading. Photo courtesy of Hartford Steam Boiler Inspection & Insurance Co.

No Build-Up! No Blow-Up!

. . . WHEN MODEL 1106 PROPORTIONEER FEEDS BOILER WATER CHEMICALS

Prevent scale build-up (caused by boiler carry-over) on turbine blades with proper raw water or internal steam boiler treatment. Model 1106 Proportioneer feeds all chemicals (alkaline, neutral, or acid) accurately (guaranteed within ±1%) over 15 to 1 range. Capacities range from 0.11 to 35.6 GPH . . . for discharge pressures up to 1100 psig.



In-Motion Stroke Adjustment offers the ultimate in convenience for controlled chemical feeding. Stroke length adjustable (no tools required) in stepless increments over entire range of pump while pump is in operation!

PAY LESS, GET MORE!

Design features of this proportioning pump include interchangeable measuring cylinders, super-accurate Vane-Guide check valves, and percentage calibrated stroke-length scale.

Request Bulletin 1106-2 for complete data. Write to **PROPORTIONEERS, INC., 385 Harris Avenue, Providence 1, Rhode Island.**

PROPORTIONEERS
DIVISION OF
B-I-F INDUSTRIES METERS FEEDERS CONTROLS

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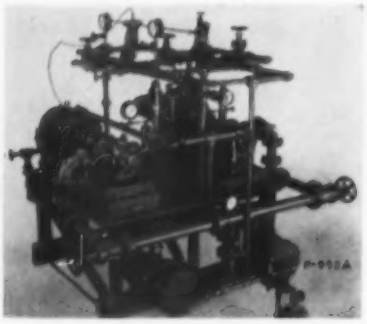
COMPLETE RANGE OF SIZES AND MODELS IN BOTH MEDIUM AND HIGH PRESSURE TYPES

MORE COMPACT THAN EVER . . .



P-952-A—Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-852M size No. 25 unit.

NATIONAL AIROIL

FUEL OIL PUMPING AND HEATING UNITS

NATIONAL AIROIL Fuel Oil Pumping and Heating Units are specially designed to prepare, for combustion, all grades of fuel oil including No. 6 or Bunker "C" Oil and residuums. They will draw fuel oil from above ground or underground tanks, preheat it to proper constant temperature and deliver it to Oil Burners at an even pressure, best suited for the burners. Our Fuel Oil Pumping and Heating Units are the result of years of experience. They come completely equipped ready for steam, exhaust, condensate, oil suction, oil return, and electrical connections. All valves, regulators, etc., are readily accessible. The piping arrangement is easily understood. These compact, space-saving units are available in a range of sizes and models in both Medium and High Pressure types. For complete details, write for our Bulletin 40—very interesting and informative.

OIL BURNERS and GAS BURNERS for Industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
SLUDGE BURNERS, Steam Atomizing
MOTOR-DRIVEN ROTARY OIL BURNERS
MECHANICAL PRESSURE ATOMIZING OIL BURNERS
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LOW AIR PRESSURE OIL BURNERS
AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
GAS BURNERS
COMBINATION GAS & OIL BURNERS
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similar applications. An independently adjustable automatic reset feature extends its use to many automatic control fields. The switch can be mounted in any position, says company, and its use is not affected by vibrations. It requires only 1 1/4-in. headroom, fits into an area of 3 1/2-by-7 1/2 in. Since there is no flow through sensing element, the connecting tubing may be as small as 1/8-in. ID.

Pressure, vacuum or differential pressure will operate the switch. Normal range is 0.1 to 5.0 in. water; other ranges can be provided. The switch is designed for a-c and d-c use up to 110 v. Bacharach Industrial Instrument Co.

31—TAPE HOLDER aids in making charts and graphs

Tape-Pen is a metal holder-dispenser for this company's line of Curve-Line Tapes. It comes in sizes to fit tape widths of 1/4, 1/8 and 1/16 in. Roughly triangular in shape, and weighing less than 2 oz, the Tape-Pen is easily held in the hand, and applies the printed tape quickly, following a straight edge, French curve, or freehand design. Three bearing points — the roller through which the tape is fed, the heel, and a metal foot extending from the side of the instrument — keep it at right angles to the work surface to assure flat application of the tape. The Tape-Pen costs around $7.00. Chart-Pak, Inc.

32—NON-LIVE EXTENSION REELS handle light cord, heavy cable

Two portable cable reels featuring wide adaptability have no current collector, sliding brushes or spring contacts, manufacturer announces, and they handle any size wire or cable. Adjustable steel

pins can be inserted to fit desired coil diameter, with the lock-bearing adjustable to any coil width. Loading requires only pulling one end of the cord through an opening in the removable side plate and coiling the cord on inside and outside of the reel, ready for use. Model NL-15 measures 15 in. in diameter, handles 150 ft 12/2 cord; Model NL-18, 18-in. diam, 250 ft, 12/2 cord. Both models are of welded steel construction. Hykon Mfg. Co.

33—CONTROL CENTER for groups of a-c motors

The Class 11-350 Control Center houses control for three-phase a-c systems at 220 v (1-100 hp) and 600 v (1-200 hp). All controls are centralized in one group of stationary, interchangeable enclos-

DEOXY-SOL
SOLUTION OF HYDRAZINE

- Oxygen-
- Scavenger
- for
- Boiler Water
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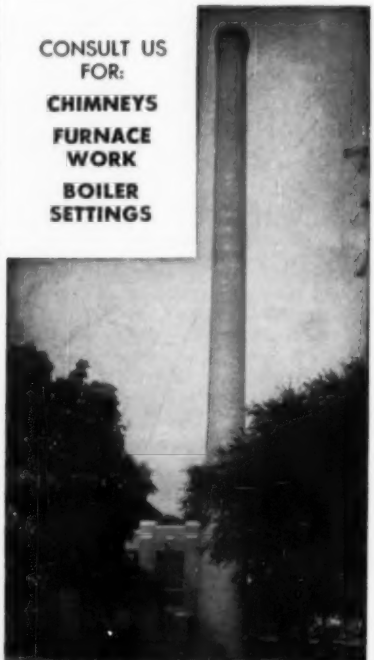

AMERICAN CHIMNEY CORP.
143 Fourth Ave., New York 3, N. Y.
BRANCHES: CHICAGO
BOSTON • PHILADELPHIA • CLEVELAND
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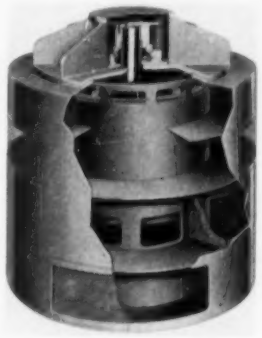
ures, each with a grouping of modular starter units. Individual structures are 90⅜ in. high and 20 in. wide, and may be combined in straight-line, L-shape or U-shape assemblies. They are available for both front mounting and back-to-back mounting of controls, in NEMA 1 indoor or NEMA 3 outdoor weather-resistant enclosures. Each structure contains a main horizontal three-phase bus lowered 12 in. from the top, and a three-phase vertical bus for distribution of power to starter units. Starter units are available in NEMA Type A with no terminal, NEMA Type B with individual terminal blocks on each starter, or NEMA Type C with individual unit terminal blocks and complete factory wiring to master terminal blocks at top or bottom of each structure. Westinghouse Electric Corp.

34—REGULATOR-FILTER-LUBE is one compact unit

Designed to regulate to desired pressure, filter water and air from the air line and lubricate air stream with a fine fog-like oil mist, this three-in-one combination regulator-filter-lubricator is ready to install and requires only two connections. Regulator operates on a balanced piston principle. Automatic bleed-off serves to permit sensitive pressure reduction without bleeding down-stream line. Regulator is designed to furnish accurate regulation to 0, where it serves as a shut-off valve. Pressure gage of 0 to 200 lb is included. Cyclonic action within the filter bowl removes dirt and water; a second filtering takes place as air passes through filter cartridge. External oil adjustment meters lubricant, which automatically enters air stream as an oil mist, ideal for pneumatic tools and equipment. The unit is available in ¼- to ¾-in. pipe sizes. Brochure 80 gives more details. Perfecting Service Co.

35—VERTICAL MOTORS in weather-protected enclosures

Vertical weather-protected motors with enclosures built to NEMA Type II standard are available in squirrel-cage and wound-rotor induction and synchronous types in ratings of 250 hp and up. For outdoor applications on pumps



and other vertical drives, motor's ventilating passages are constructed to minimize entrance of rain and airborne particles, with baffles to direct flow of air in and out. Intake and exhaust openings to air chambers are arranged so high velocity air blown into machine will circulate through and be discharged without entering internal vent passages leading to electric parts.

Baffles force incoming air to abruptly change its direction — 90 deg or more — before reaching motor's electric parts. To further assure that moisture or dirt particles will drop out before reaching internal parts, air velocity into machine is less than 600 rpm. Filters are optional. A permanent wire-mesh type is used, when specified, and filter sections are readily accessible for inspection and maintenance. Space heaters, standard on machines for out-door service, are hairpin shaped, immersion-type units with integral terminal boxes arranged so that electrical connections inside machine are eliminated. Bulletin 05R8685 gives details. Allis-Chalmers Mfg. Co.

36—CONTROL VALVE for greater proportioning accuracy

This proportioning control valve is designed to provide greater accuracy by a longitudinal stem lift in line with piston. When installed with line air pressure (up to 100 psi) it is claimed to provide accurate and safe automatic or remote control. The metering valve with the removable orifice seat, coupled with a Cono control, is manufactured for a range of pressure from 6,000 to 30,000 lb and sizes from ⅛ to ¾ in. It can be specified to meet explosion proof requirements and is available in various materials including 316 stainless steel, Hastalloy and Monel metal. It can be supplied in a complete package, if desired, with electronic pressure sensing device for automatic operation. High Pressure Equipment Co., Inc.

PROFESSIONAL SERVICE

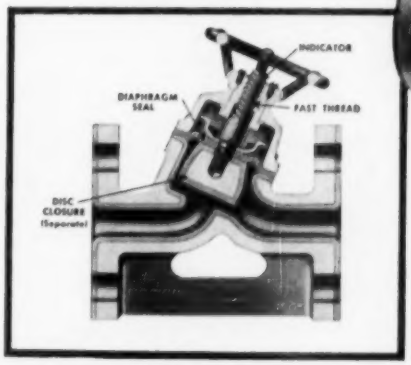
THE LUMMUS COMPANY
Engineers and Constructors
385 Madison Avenue, New York, N. Y.
Chicago — Houston — London — Paris — The Hague — Montreal — Caracas — Bombay

J. E. SIRRINE COMPANY
Engineers
Design and Supervision of Steam and Hydro-electric Power Plants, Industrial Plants, Mechanical and Operating Surveys, Appraisals • Plans • Reports
Greenville, South Carolina

The Kuljian Corporation
ENGINEERS • CONSTRUCTORS • CONSULTANTS
POWER PLANT SPECIALISTS
(Steam, Hydro, Diesel)
UTILITY • INDUSTRIAL • CHEMICAL
1200 N. BROAD ST., PHILA. 21, PA.

USE
CLASSIFIED ADVERTISING
It Pays

Best by Far - for Low Cost Corrosion, Abrasion, Vacuum and General Service
W. S. ROCKWELL
DIAPHRAGM VALVE



Always closes
Diaphragm seals mechanism
Write for Bulletin

- No packing gland to leak. Mechanism not exposed.
- Oversized ports; high capacity; low pressure drop. Largest capacity of any diaphragm type valve.
- Self-draining in horizontal position.
- Closure is by rubber disc.
- Lower handwheel torque and fewer turns to close.
- Automatic control available.
- Body of any metal or with any lining.
- Sizes ½" to 6".

W. S. ROCKWELL COMPANY — 2947 Eliot St., Fairfield, Conn.

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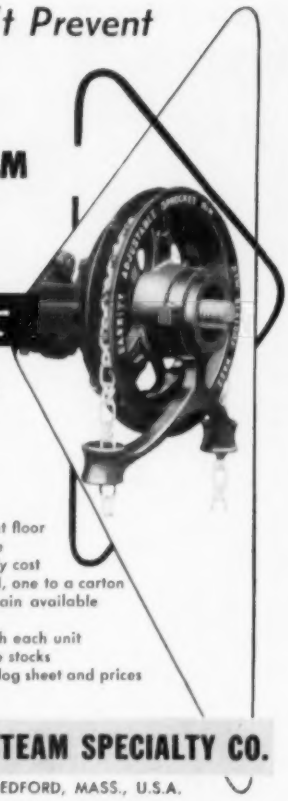
Insurance Can't Prevent Accidents—

A BABBITT SPROCKET RIM CAN!

THINK of

Babbitt

Adjustable
SPROCKET RIM
with Chain Guide



- Simplifies pipe layout
- Fits any size valve wheel
- Easy to install and operate
- Operates any valve from plant floor
- Time and money saving fixture
- No maintenance; first cost only cost
- Packed, completely assembled, one to a carton
- Hot galvanized, rust-proof chain available for all sizes
- Easy to follow instructions with each unit
- Your supplier carries complete stocks
- Write for new descriptive catalog sheet and prices

Babbitt STEAM SPECIALTY CO.

4 BABBITT SQUARE, NEW BEDFORD, MASS., U.S.A.

For more data circle 568 on Post Card

KOR and OXI

SUPERIOR ADDITIVES FOR CLEANING THE FIRESIDE OF OIL AND COAL BURNING FURNACES AND BOILERS

KOR *FOR OIL*

A superior sludge dispersant; plus a combustion catalyst which keeps the entire fuel oil system clean (tank to stack inclusive) without labor involved. Obtains more steam or more heat with less oil at less cost than ever before.

FOR COAL **OXI**

An atom-like chemical crystal which completely oxidizes all combustible deposits on convection surfaces, superheaters, waterwalls, economizers, air-preheaters, breechings and stacks. Increases combustion and reduces boiler operating and maintenance costs.

DIRECT FACTORY SERVICE • WRITE FOR BULLETINS AND PRICES

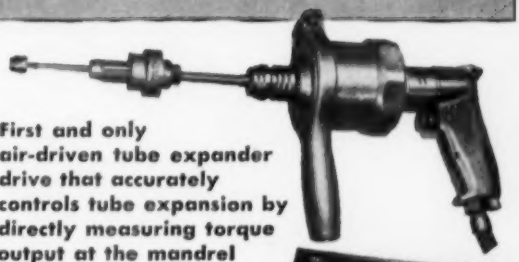
KOR AND OXI CORPORATIONS

MAIN PLANTS AND GENERAL OFFICES
600 WEST 9TH AVENUE
GARY, INDIANA

For more data circle 569 on Post Card

For Expanding Heat Exchanger Tubes

NEW WILSON Torq-Air-Matic



First and only air-driven tube expander drive that accurately controls tube expansion by directly measuring torque output at the mandrel

Only the Wilson Torq-Air-Matic offers all these features: air driven, automatic trip-off, completely integrated, non-electrical, non-frictional, calibrated in ft lbs torque, lightweight, simply adjusted.

Send for your copy of Wilson Bulletin 55.

Wilson Heavy-Duty Air Driven Cleaners

offer quick way to clean fouled heat exchanger tubes

Wilson Tube Cutter

easy to use, does fast job, a fine, reasonably priced tool

Representatives in principal cities
Thomas C. Wilson, Inc. • 21-11 44th Ave., Long Island City 1, N. Y.
Cable address: "Tubeclean", New York

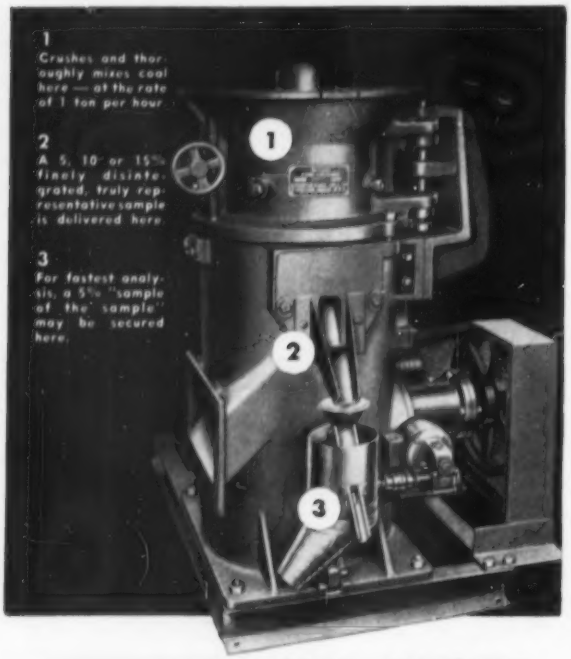
WILSON

TW 868

TUBE CLEANERS • TUBE EXPANDERS

For more data circle 570 on Post Card

Samples Coal Shipments in a Matter of Minutes!


1
Crushes and thoroughly mixes coal here — at the rate of 1 ton per hour.
2
A 5, 10 or 15% finely disintegrated, truly representative sample is delivered here.
3
For fastest analysis, a 5% "sample of the sample" may be secured here.
1
2
3

STURTEVANT COAL SAMPLER

with New Automatic Splitter

It's a fact! Big users of coal and coke know the true B.T.U. value of deliveries before moisture has a chance to evaporate . . . thanks to the speedy crushing, homogenizing and proportioning actions of the Sturtevant Automatic Coal Sampler and its Automatic Splitter. So, they get what they pay for . . . and increase boiler efficiency in the bargain.

Handles a ton an hour! The Sturtevant Automatic Coal Sampler takes 3" or smaller coal or coke and crushes it to 6 mesh or finer. Sample spout takes off 5, 10 or 15% of the finely crushed homogenous mixture, as desired. Then, the optional Automatic Splitter takes a 5% "sample of the sample."

"OPEN-DOOR" DESIGN

provides "One Man, One Minute" accessibility for all cleaning and maintenance — an exclusive Sturtevant feature that saves valuable down-time.

Want more information? Write for all the facts about the Sturtevant Automatic Coal Sampler — the tested shortcut to accurate B.T.U. analysis.

STURTEVANT

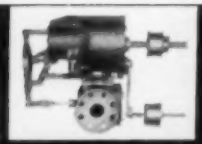
MILL COMPANY

145 Clayton St., Boston 22, Mass.

CRUSHERS • GRINDERS • MICRON-GRINDERS • SEPARATORS
BLENDERS • GRANULATORS • CONVEYORS • ELEVATORS

For more data circle 571 on Post Card

STOP WASTING STEAM



Type EN Governor Fully enclosed, Self-lubricated

Let Troy Steam Engines and Generators produce dollar-saving "BY-PRODUCT POWER" from steam available for processing or heating. You can use this low-cost power for many operations in your plant, even against high back pressures!

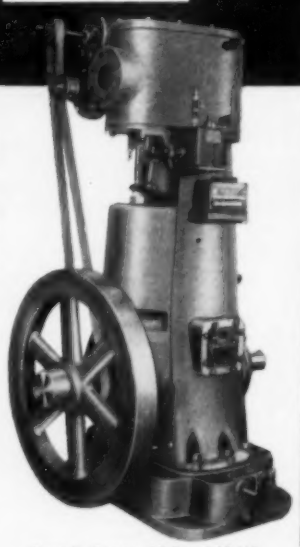
Use it for—

Generating Electrical Power

Mechanically Driving stokers, pumps, fans, compressors and other equipment.

It will pay you to investigate this source of cheaper power. TROY Equipment can be your key to COST REDUCTION!

Send for Booklet #306.



Type E Engine, 12.5 to 100 HP.

TROY Engine & Machine Co.

704 Parsons Street Troy, Pennsylvania Tel. Troy 32

For more data circle 572 on Post Card

this NO-COST TEST OFFER has CONVINCED thousands

. . . send for **YOUR FREE "TEST CAN" of C-5 "hi-temp" ANTI-SEIZE THREAD COMPOUND!**

For use wherever threaded connections are subjected up to 1800°F. temperatures such as boiler, manhole, face plate studs, cylinder heads, and manifold studs or flange bolts on high temp steam lines and pumps.

Try C-5 and see why manufacturers, refiners and power producers have made it a part of their regular preventative maintenance program.

fel-pro C5 "HIGH-TEMP"

- ✓ Ends Seizing and Galling even up to 1800°F.
- ✓ Reduces Wrench Torque
- ✓ Ends Stud Breakage
- ✓ Permits Repeated Re-use
- ✓ Speeds Assembly and Disassembly
- ✓ Protects Stainless Steel at all Temperatures

1614-BR

ANTI-SEIZE THREAD COMPOUND

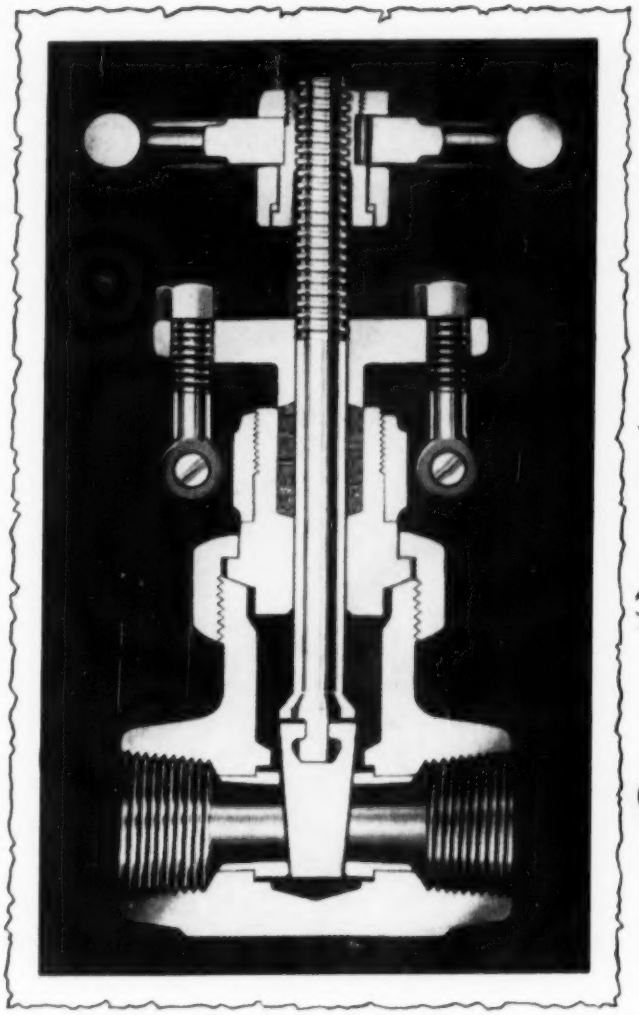
C-5's exclusive colloidal copper formula separates mating metal threads and surfaces with cushioning, protective copper plating. C-5 prevents galvanic action and eliminates pitting even when dissimilar metals join. On mating metal surfaces, C-5 saves gaskets and countless man hours.

WRITE TODAY . . . For Your FREE Test Sample Can of C-5.

FELT PRODUCTS MFG. CO.

Dept. 76, P.O. Box 8609, Chicago 80, Ill.

For more data circle 573 on Post Card



The Feeling is
MUTUAL

CHAPMAN LIST 960
Forged Steel Gate Valves

You want small steel valves that give the best performance and cost the least for maintenance. Chapman thinks the same way and does everything possible to give you what you want.

On Chapman List 960 Forged Steel Gate Valves the wedge faces are *super* hard. They're hardened to 800 Brinell by Chapman's exclusive Malcomizing process. They can't seize. They can't gall. They're built for rugged service.

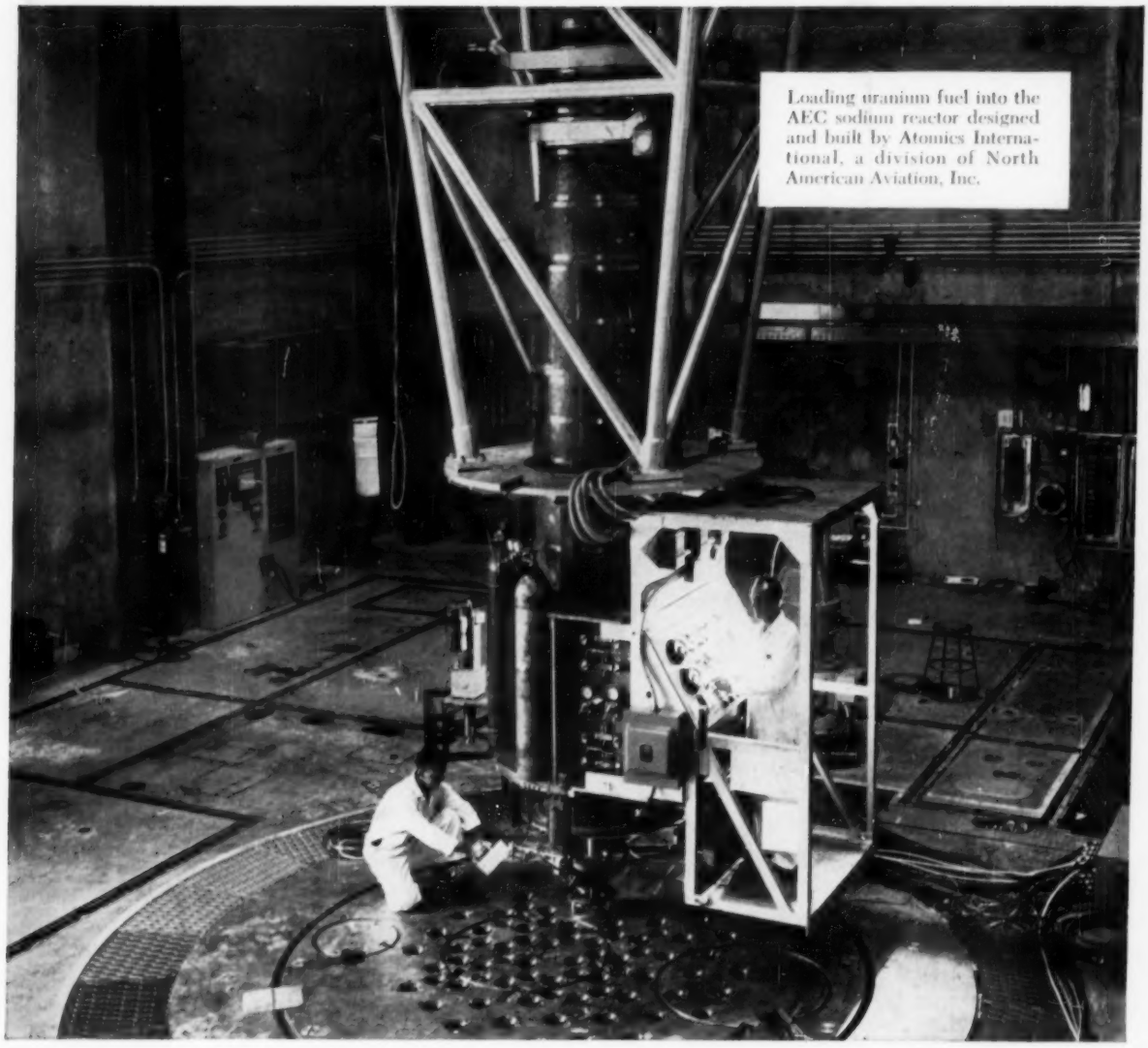
Even the long lasting seat rings are hardened stainless steel and are very easy to replace when necessary. Also, you have no full-pressure repacking difficulties with Chapman List 960 valves.

Today, there are more Chapman List 960 valves on more jobs than any other small forged steel gate valve. Valve men and Chapman see eye to eye on performance and costs. List 960's come in sizes from ¼" to 2". They stand up perfectly under conditions from 380 psi at 1000°F. to 2000 psi at 100°F. Of course, for higher pressures you use Chapman List 990 valves.

With the 960's you can order Bonnet joint either gasketed or ground metal-to-metal. You can have rising stem with yoke or rising stem with inside screw. You find them all in our Catalog 10. Write today for a copy.

The CHAPMAN
Valve Manufacturing Co.
INDIAN ORCHARD, MASSACHUSETTS

For more data circle 574 on Post Card



Loading uranium fuel into the AEC sodium reactor designed and built by Atomics International, a division of North American Aviation, Inc.

Water for new Atom Power Plant is 99.999992% pure!

• Southern California Edison Co. . . . now generating current from this new reactor in the Santa Susana Mountains . . . is the first private utility to produce electricity from a non-military reactor.

As in any system using water or steam in or near an atomic reactor, the quality of the water at the Santa Susana plant is important. Suspended and dissolved mineral solids must be removed to prevent them from depositing in boiler tubes and turbines. In other types of reactors, these solids can also pick up and carry radioactivity and could make turbines and other equipment difficult for maintenance or repair.

Although this plant's water supply is a clear well water, it contains almost 600 parts per million of hardness salts and other dissolved solids. The Permutit softener and demineralizer reduce these solids to 1/12 part per million . . . a purity of 99.999992%!

Permutit was chosen to design and supply this precise and critical equipment because of its long experience in water conditioning.

If your problem is Water . . . for industrial, municipal or home use, we'd like to discuss it with you. Address: The Permutit Company, Dept. PE-11, 50 West 44th St., New York 36, N. Y. or Permutit Company of Canada, Ltd., Toronto 1, Ontario.

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